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Caste As A Determinant Of Utilization Of Maternal And Neonatal Healthcare Services In Maitha, Uttar Pradesh, India

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CASTE AS A DETERMINANT OF UTILIZATION OF MATERNAL AND NEONATAL HEALTHCARE SERVICES IN MAITHA, UTTAR PRADESH, INDIA

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ABSTRACT

Caste among Hindus in India is a non-modifiable socio-demographic characteristic, often the basis of segregation and discrimination. Despite the provision of subsidized maternal and child healthcare services, utilization in rural Uttar Pradesh (UP), India is poor. Studies showed that upper caste (UC) women were more likely to utilize healthcare services than the lower caste (LC) women but this association is inadequately researched.

We explored whether caste was a determinant of utilization of maternal healthcare (MH) and neonatal healthcare (NH) services among rural Hindu women and neonates in Maitha, UP, India. Data from the 'Morbidity and Performance Assessment' study for 482 women who were pregnant during Jan 1998-Jan 1999 and their 464 live born singleton neonates were analyzed. Through multivariable logistic regression analysis we estimated the crude odds ratios of higher utilization of maternal/neonatal healthcare services by UC women/neonates compared to the LC women/neonates. Odds ratios were adjusted for neonate's gender, maternal age, parity, literacy, number of living sons/brothers, and socio-economic status.

Utilization of all MH and NH services was lower than expected. UC women were twice as likely to utilize antenatal care (ORa=2.39, 95% CI: 1.21, 4.71) and tetanus toxoid (ORa=2.19, 95% CI: 1.28, 3.73) and almost 5 times more likely to be attended by a trained professional at birth (ORa=4.77, 95% CI: 1.81, 12.54) than LC women, after adjusting for the socio-demographic factors. UC women were as likely to utilize iron folic acid, post partum care, contraceptives, and treatment outside home as LC women. NH services utilization such as aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth and until cord fell off), routine neonatal care, and treatment outside home did not vary by caste. Number of living sons/brothers, socio-economic status, and maternal literacy were other significant determinants.

Caste was a significant determinant of basic MH services utilization even after adjusting for the socio-demographic factors. Health policies and programs can overcome low utilization and caste disparities by encouraging participation of LC groups in health-care delivery, combining services and making them available through one provider, and by generating awareness about the available services.

DEDICATION

To Ma and Papa, who taught me that hard work and self belief are essential ingredients to succeed in life. Without these two virtues it would have been impossible to complete this dissertation work. To Mona, world's best sister, who would gladly hold my hand and help me sail through the rough tides on this side of the Atlantic! Her emotional and moral support during this work was very crucial. To Montu, my adorable brother, who would send me the positive vibes and wisdom time to time. His belief in my abilities was truly inspirational.

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LIST OF ABBREVIATIONS

ANC	Antenatal Care/Check-up
ANM	Auxiliary Nurse Midwife
BC	Backward Caste
CI	Confidence Interval
IFA	Iron Folic Acid
LTC	Life Threatening Complication
MAP	Morbidity and Performance Assessment
MCH	Maternal and Child Health
NFHS-I	National Family Health Survey-I (1992-93)
NFHS-II	National Family Health Survey-II (1998-99)
NNC	Neonatal Care
OBC	Other Backward Caste/Class
ORa	Odds Ratio Adjusted
ORc	Odds Ratio Crude
PPC	Postpartum Care
SC	Scheduled Caste
SD	Standard Deviation

SES	Socioeconomic Status
TT	Tetanus Toxoid
UP	Uttar Pradesh

INTRODUCTION

India, with a population of over 1 billion and with a population density as high as 274 persons/km^2, is one of the most densely populated countries in the world.[1, 2] India is also known for its cultural and religious diversity. Of many religions that are practiced in the country, Hinduism is the predominant religion, followed by as many as 80% of the population.[2-7]

Among Hindus, caste is the basis of hierarchical social organization and stratification.[3-8] Caste stratification has led to the social exclusion and exploitation of those at the lower levels of the caste hierarchy.[3, 4, 6, 9] Lower caste people have failed to benefit from the economic development programs as well as subsidized healthcare services that are provided by the government.[6, 10, 11] The Government of India has taken affirmative action to eradicate caste discrimination and to create a "caste-less society".[1-4, 6, 12-14] However, marginalization of lower caste people is still reported.[3-7, 13]

Recent national level health data shows that approximately 16% of the nation's population belongs to lower caste groups known as the scheduled caste (SC).[1] Neonatal, post-neonatal, and infant mortality rate among the SC are much higher than the national average.[1]

The Government of India has modified the public health policy and the National Population Policy on several occasions to improve the health of its people, but in vain.[15, 16] In the year 2000 the Maternal Mortality Ratio was reported to be 540/100,000 live births and the Neonatal Mortality Rate for the country was reported to be 43/1,000.[17]

Uttar Pradesh (UP), one the most populous and largest states in India, significantly contributes to the country's population growth and poor health indicators.[18-20] UP is largely rural (80%)[2, 3, 20, 21] and predominantly Hindu (83%).[1-3, 21] Although, the infrastructure (public and private) for the provision of healthcare services in India is very large and diverse,[22] the use of healthcare services is reported to be very low especially among rural women and children.[11] In UP, a negligible proportion of women utilize maternal healthcare services.[21] According to the National Family Health Survey-II (NFHS-II) in 1998-99[1] only 35% women had utilized Antenatal Care (ANC),[1] 51% utilized Tetanus Toxoid (TT),[1] 32% utilized Iron Folic Acid (IFA),[1] 5% utilized trained birth attendants,[21] and only 22% utilized any contraceptives.[21] Data are not available to analyze the status of utilization of Postpartum Care (PPC) and Neonatal Care (NNC) services in UP. The status of maternal and neonatal health in UP is dismal.

The reasons for low utilization of the highly subsidized Maternal and Child Health (MCH) care services[22] are not known. Health studies from India have not adequately addressed the potential determinants of poor healthcare services utilization, especially in rural areas. Probably underutilization of healthcare services is determined by socio-cultural factors such as caste.

The goal of this dissertation research was to explore if caste is a determinant of maternal healthcare services utilization and neonatal care as well as neonatal healthcare

services utilization. The primary objective of this research study was to examine if caste is a determinant of the utilization of maternal healthcare services among Hindu women and if caste is a determinant of neonatal care and neonatal healthcare services utilization among live born singleton Hindu neonates in UP, India. The secondary objective was to determine if caste is a determinant of the utilization of maternal healthcare services and if caste is a determinant of neonatal care and neonatal healthcare services utilization after adjusting for the socio-demographic factors such as gender of the neonate, maternal age, maternal parity, number of living sons/brothers, socio-economic status (SES) score, and maternal literacy among Hindu women and live born singleton Hindu neonates in UP, India. Optimum utilization of available healthcare services is a catalyst in improving health status of women and children.

This dissertation describes how the above mentioned study objectives were met. The dissertation is divided into five sections. First section, Introduction, describes caste-based discrimination among Hindus in India. Healthcare policies and status of maternal and child health in India and UP are also presented. The review of the literature that describes the association between caste and utilization of maternal and neonatal healthcare services as well as other potential determinants of poor utilization of healthcare services are also presented. In second section, theoretical basis, conceptual framework, study aims, research questions, and hypotheses are described. Third section describes the research methodology that was applied to address the study hypotheses. Study design, data source, study sample, and data analysis methodology are also described in this section. In fourth section, the results from data analyses are presented that systematically answer each research question and hypotheses. In the fifth and final section of this dissertation

study findings are summarized and discussed, as well as the significance, strengths, and limitations of the study are presented. Suggestions to overcome caste disparities in maternal and neonatal healthcare services utilization are also discussed in this section.

Background and Setting

India as a Caste-Based Society

India, with a population of 1,028.7 million,[1] is the second most populous[9, 14, 19, 23] and the seventh largest country in the world.[2] The country is governed by a democratic federal system that includes the union/central government, 35 states and union territories, 593 districts, and in most states, three lower levels of local governments at the district, block, and village levels.[15] With 17% of the world's population[2] living in this country the population density is 274 persons/km^2.[1] About 50% of the male and female population is in the age group of 15-45 years.[2] The demand for maternal and child healthcare services is therefore enormous.

India is not only a union of states, it is also an amalgamation of castes, tribes, and communities.[24] The country is geographically,[13, 14] linguistically, culturally, and religiously diverse.[14, 25] Even broad comparisons between states and districts reflect enormous variations in basic demographic indicators.[14, 25] Hindi and English are the official languages.[2] Besides these two languages 30 other languages and 2000 dialects are widely spoken.[2] Six major religions in the country are widely practiced indicating religious tolerance and diveristy.[2] Hinduism is the predominant religion in India, practiced by as many as 80% of the population.[3-7]

Among Hindus, caste is the basis of hierarchical social organization and stratification.[3-8] Caste, which is a function of *varna* (color of the skin)[13, 26] and *jatis* (traditional family occupation)[7, 13, 27] is an ascribed status determined at birth and fixed for life.[3-5, 7, 12] Although there are numerous castes, historians report four main caste groups: *Brahmin* (priests or philosophers), *Kshatriya* (rulers or warriors), *Vaishya* (merchants or artisans), and *Shudra* (laborers or unskilled workers).[7, 13, 26] The social distance between the caste groups varies from region to region but in general, there is a well established non-modifiable hierarchy of castes.[7] Historians report that the first three caste groups belong to the upper caste category and the *Shudra*, is the lowest caste group.[9, 26] Communities have the flexibility to divide and organize caste categories into specialized sub-groups based on the traditional occupation of the family (e.g., shoemakers, scavengers, and butchers are some of the sub-groups of *Shudra* caste).[7, 13, 27] Traditional rural societies are known to modify the ranking of the caste sub-groups in order to ensure the smooth functioning of the social institutions. Uniform patterns in ranking may not be observed across the country or regions. Similarly, the caste status or titles in one part of the country might not be the same in another region.

According to the Hindu religion, lower caste people or *Shudras* are considered 'untouchable',[7, 11, 28-30] implying that they can 'contaminate' or 'pollute' the people and the environment they come in contact.[7, 29, 30] Lower caste people are expected to do menial and unskilled jobs in the community such as scavenging, discarding human and animal corpses, assistance with delivery, etc. For example, in Maitha, UP, births are attended by *Dai* and *Dhankun*, the traditional birth attendants, who belong to the *Shudra* caste group. *Dai* helps to deliver the baby, and *Dhankun*, whose caste position is even

lower, is responsible for disposal of placenta, umbilical cord care, and cleaning the woman after child birth. These jobs expose the traditional birth attendants to the unhygienic and unclean environment consequently upper caste people prefer to avoid contact with lower caste people to avoid contamination. The rural social morphology[27] makes provision for segregation of upper and lower caste groups to avoid this 'pollution',[7, 29, 30] e.g., the source of drinking water, such as a well, is not shared by people of different caste groups.[29, 30] Facilities and resources, such as places of worship, water sources, electricity, health facilities, healthcare providers, etc., are not shared between different caste groups.[27, 29, 30] The lower caste people often inhabit resource-poor parts of the village.[27, 29] Lower caste people either hesitate to utilize the resources outside of their community or the upper caste people do not permit them to use shared resources.[27, 29] Besides, derogatory, demeaning, and insulting terms are used to refer to lower caste people which reinforces social distancing.[29]

Caste discrimination made Hinduism unpopular and as a result new religions such as Sikhism and Buddhism came into existence to overcome such inequities of Hindu religion.[26] Islam and Christianity which were free of caste-based segregation also gained popularity.[26] Many Hindus converted to these religions,[26] however, with the passage of time, the 'caste free' characteristic of new religions was lost and the converted Hindus resumed caste discrimination. As a result, 'casteism', a mechanism for social discrimination, is practiced by people across all religions in India today (e.g., Islam, Christianity, Sikhism, Buddhism, etc.[26]), since it conveniently reinforces existing inequalities.[29] Certain elements of caste discrimination such as prohibition of inter-caste marriages and inter-caste dinning are still practiced by Hindus and those Hindus who had converted to

other religions. Not only in India, but also in neighboring Nepal and Bhutan, both Hinduism and caste-discrimination are widely practiced.[5, 31-36] Caste discrimination affects a large number of people in the Indian subcontinent.[29] It is a barrier to social elevation and upward mobility.

The caste organization has lead to the social exclusion and exploitation of those at the lower levels of the caste hierarchy by the upper caste groups.[3, 4, 6, 8, 9] Historically, people belonging to the lower castes have been placed in the lowest class groups of the Hindu society.[8] Lower caste people are denied entry into well paying occupations, they have to earn a livelihood through unclean and menial jobs.[6, 12, 37]As a result they are not only socially deprived but also economically deprived.[6, 9, 10, 12, 37, 38] On the other hand, high-caste Hindus either confine themselves to their homes or are engaged in better paying and prestigious jobs.[37-41] Higher caste Hindus had enjoyed the privileges such as rights to worship and to perform religious rituals, as well as rights to higher education or martial arts, etc., among others. In ancient India, upper caste people who had the privilege to engage in such activities enjoyed closer proximity to the king and the god; consequently, upper caste people could overcome economic and social deprivation whereas the lower caste people languished in poverty at the bottom of the hierarchy.

Caste and Modern India

Soon after independence from British rule (1947), the leaders of the nation recognized the need to eradicate caste discrimination.[7] Untouchability was outlawed and the traditional caste classifications were discarded and new non-discriminatory and non-

offensive terms were introduced.[7] Dr. B. R. Ambedkar, Chairman of the 'Drafting Committee of the Constitution of India', developed two schedules incorporating all of the castes and tribes that had historically faced discrimination and exploitation.[7] In Article 341 and 342 of the Constitution, the Govt. of India identified those castes occupying the lowest rung in the social hierarchy as the "Scheduled Castes (SC)".[1-4, 6, 7, 12, 14, 42] Henceforth, lower caste groups have been referred to as SC by the Govt. of India.

The original schedule of caste and tribes has been modified, amended, and supplemented from time to time to include other underprivileged caste groups.[7] The updated series, 'Scheduled Castes and Tribes Orders (Amendment Act) 1976', included many other economically backward caste groups under 'Other Backwards Castes' (OBCs) and 'Backward Castes' (BCs) category.[3, 4, 7, 30] The updated series expanded the scope to include people from all caste groups who have economically lagged behind. As a result people belonging to BC and OBC categories may be upper caste.

The government has taken affirmative action on multiple occasions to reverse the disadvantaged position of SC, BC, and OBC and to protect these groups from injustice and exploitation.[1, 3, 6, 7, 12, 14, 30] Proportion of seats for SC, BC, and OBC have been reserved in educational institutions, employment, and in legislatures and the parliament.[1, 3, 6, 7, 12, 30] People belonging to these groups are also offered equal opportunities with the provision of subsidized food, allotment of scarce resources, healthcare, legal aid, and financial loans.[1, 3, 6, 7, 12, 30] Such privileges have been provided for over 50 years.[7] The public legitimacy of caste is somewhat diminishing and caste status is no longer a marker of vertical relative rank but merely a marker of cultural distinctiveness.[8] Over time as the

importance of caste hierarchy diminishes the adverse effects of caste discrimination on the health of lower caste people may alleviate.[8]

Caste, Poverty, and Gender – Barriers to Healthcare

Unfortunately, despite the state's affirmative efforts, caste discrimination still persist. Even today, caste is a household-level characteristic or a community factor that could facilitate or hinder the health-seeking behavior of community members.[10, 37]

Researchers speculate that higher caste Hindus have greater access to healthcare services because of their higher educational level, better economic status, participation in community development activities, etc.[37, 40] Conversely, lower caste Hindus probably utilize fewer healthcare services due to the fear of ill-treatment, arrogance, or indifference by health personnel.[37, 40]

Studies have shown that fewer SC women receive ANC,[11] maternal healthcare services,[10, 37] curative health services from qualified providers,[43] gynecological services,[4] and contraceptives[6, 44] compared to higher caste women. Lower caste women also report discrimination at health facilities.[17, 33, 45] Fewer lower caste people seek medical care[33, 46] due to long travel distance, cost, and 'bad treatment' by the provider.[33] Caste disparities in infant feeding practices,[38] sex ratios,[41] still births,[47] umbilical cord infections,[48] neonatal deaths,[47] infant deaths,[37, 44] and death rates[8, 37, 46] have also been reported.

There is a general lack of access to healthcare services for the socially backward communities[6, 10, 11] due to residential segregation[29, 30] and untouchablity.[7, 11, 28-30] The spatial disadvantage combined with the social and economic seclusion of these groups could

contribute significantly to the relative under-utilization of maternal healthcare services among SC communities.[10, 28] A few researchers have speculated the relationship between caste affiliation and healthcare service utilization to be positive.[28, 40]

Besides caste, poverty is often a basis for discrimination and may result in abuse, neglect, and inferior treatment at health facilities.[17] Moreover, higher caste affiliation is known to be positively correlated with higher household income and higher SES.[4, 7, 10, 17, 33, 37-39, 43, 49, 50] Consequently, the higher the caste affiliation the better the overall health of the individuals, leading to fewer healthcare needs which can be sought at competent healthcare facilities.[4, 10, 17, 33, 39, 43, 49, 50]

Among the socially marginalized (lower caste) and underprivileged groups (poor) in India, females are the most vulnerable.[15, 23, 51] In Hindu society there is a preference for sons over daughters because of the belief that only sons can perform some of the religious rites and inherit their father's property.[9, 12, 14] The payment to the traditional birth attendant, for the birth of a daughter is only a fourth of that for a son.[9] Birth of a son is marked with jubilation, while that of a daughter is regarded with equanimity or sorrow.[9] A predominantly patriarchal culture defines women's role in the family and in the society.[3, 14] In northern India, a young woman's prestige is a function of her reproductive performance, and the number of sons she has given birth to.[3, 14, 52]

The custom of *purdah* (veil to cover face) dictates the physical segregation of the women (irrespective of their religious affiliation) in public; consequently, women lack freedom of movement and participation in market economy.[39, 53] Socio-cultural mechanisms such as lack of property and inheritance rights, physical and social segregation, and disapproval of female education and employment have contributed to women's continued

economic dependence, domestic subordination, early, arranged, and exogamous marriages, and extended family residence.[3, 14, 50, 52, 54, 55]

Recognizing the adverse consequences of gender inequality, the 73rd Constitutional Amendment Act-1992, made provisions for facilitating gender equality by reserving 33% seats for women in jobs and in governing bodies such as the parliament.[23, 30, 51, 56] Yet, despite these affirmative actions, gender disparities still persist. One's standing in the household and in the community as well as autonomy play an important part in healthcare seeking.[17, 50, 53, 57-59] For example, female children and young women are denied access to expensive sources of treatment and disorders associated with female fertility remain within the realm of traditional therapy.[14, 17, 50, 53, 57-59] Gender inequalities in immunization,[14, 60-63] utilization of other child health services[14, 25, 41, 56, 64-70] and early mortality[14, 41, 66, 71] are widely documented. Gender is a barrier to utilization of child healthcare services in all regions of India, except in Kerala state, in southern India.[64]

In summary, caste status, socioeconomic status, and gender are significant determinants of utilization of maternal and child healthcare services such as a woman's choice of contraceptive methods,[6] fertility regulation,[50] immunization of children,[39] and the nutritional or health status of children.[39] In India, as a result, a large proportion of disadvantaged women and children remain excluded from the healthcare benefits that others enjoy indicating an increasing dualism in society and competition between social groups for scarce resources.[15, 17, 72] Exclusion from healthcare services is both external and internal.[17] 'External' sources of exclusion lie within the social structure of a community such as geographical isolation, poverty, caste, etc.[17] 'Internal' sources lie within the way the health system operates. Although the system may offer services, they would be untimely,

ineffective, unresponsive or discriminatory.[17] External and internal exclusion discourage healthcare utilization by augmenting the uncertainty regarding the availability and affordability of care.[17] Exclusion of marginalized groups is reflected in inferior health indicators and outcomes.[10, 17]

Healthcare in India

India is a peninsula in South-East Asia, surrounded by the Indian Ocean, Arabian Sea, and the Bay of Bengal[13] (Figure 1). The Himalayan range in the north protects the country from harsh climate.[13] It is also the home of many rivers and tributaries such as the Ganga, Yamuna, and Ghaghara.[13] The nation is rich with natural resources, such as fertile soil, metals, diverse fauna and flora, and above all, the hardworking people who serve as human capital to the rapidly growing agricultural and industrial economy.

The most recent national elections in 2004 have led to a relatively stable coalition government.[73] However, the volatile political situations in the past have slowed down reforms in all public spheres, including the health sector.[15]

The total expenditure on healthcare in India is estimated at 5.2% of the gross domestic product and public health investment is only 0.9%.[74, 75] The Constitution outlines the division of responsibilities in the healthcare sector among the states, central/union, and local governments.[15] The states are essentially responsible for the delivery of healthcare.[15] While 75% of India's population lives in rural areas, less than 10% of the total health budget is allocated to this sector.[1, 76] The level of central government spending across the states is quite similar and does not reflect differences in healthcare needs, per

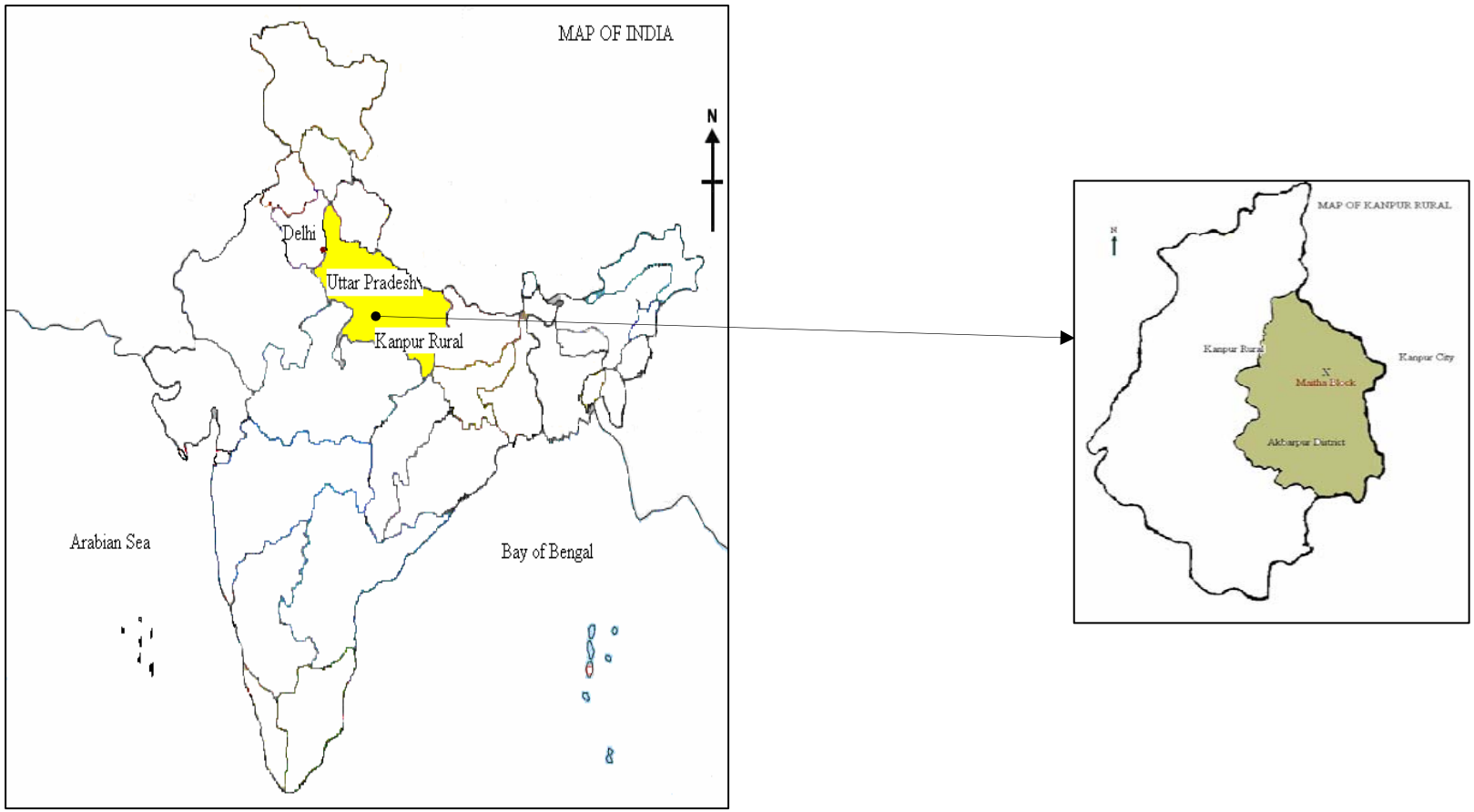

Figure 1. Uttar Pradesh, Kanpur Rural, and Maitha Block in India

Maps are not to scale

-formance of health systems, or amount of fiscal effort put in by the states.[15] Despite the rhetoric to integrate programs and strengthen local decision-making, the funding system has reinforced vertical disease control programs and a separation of health and family welfare programs.[15]A major share of the public health budget is spent on family welfare[76] and personnel salaries.[77] It has also institutionalized a centrally-based, rigid approach for the planning of personnel and healthcare facilities.[78, 79] This approach is based on population norms that have little relationship to workload, presence of the private sector or local epidemiological considerations.[78, 79]

The public health policy of India has been revised and updated repeatedly. In 1946, the Bhore Committee Report spelled out the principles for the public healthcare policy and programs in India.[16, 80, 81] The report declared that healthcare was a fundamental right of all people, not a commodity accessible only to those who could afford to pay for it.[16] India later became a strong supporter of the Alma Ata Declaration, in which it committed itself to attaining "Health for All" through primary healthcare.[82]

India uses a Five-Year Planning process to determine national goals and priorities for development investments[15, 83] (Table 1). It is through this process that priorities for family planning, 19 centrally sponsored disease control programs, and the expansion of primary care services to rural areas under the minimum needs program have been articulated and implemented across the country.[15, 16, 83] Some of the Five-Year Plans had a shorter duration due to political and economic adversities such as war, famine, etc.[78] With each Five-Year Plan the scope of MCH broadened, but each successive plan allocated less and less money (in terms of percent of total budget) to health.[76] The most recent plan, the tenth five-year plan, aims to reduce not only the Infant Mortality Rate and Maternal

Mortality Ratio but also aims to improve the availability and utilization of healthcare services among the underprivileged population.[83]

Table 1. Five-Year Plans and Healthcare Programs in India

Five-Year Plans	Healthcare Programs
First (1951-56)[11, 83]	• Antenatal Care Program • National Family Planning Program
Second (1957-60)[83]	• Economic growth
Third (1961-66)[11, 83]	• Recruitment of Auxiliary Nurse Midwives and Health Assistants • Antenatal Care to rural women
Fourth (1970-73)[83]	• Economic growth
Fifth (1974-79)[11, 83]	• Integration of Maternal and Child Health services with Family Planning services • Family Welfare Program introduced • Integrated Child Development Services Programs introduced
Sixth (1980-85)[83]	• Economic growth
Seventh (1985-90)[11, 83]	• Universal Immunization Program introduced and its integration with Maternal and Child Health activities. • Child Survival and Safe Motherhood Program introduced in 1991-92
Eighth (1992-1996)[83]	• Control population growth • Primary healthcare to all by 2000 • Emphasis on community-based health initiatives
Ninth (1997-2002)[11, 83]	• Reproductive and Child Health Program introduced in 1997
Tenth (2003-2007)[83]	• Reduce the infant morality rate and maternal morality ratio to 45/1000 and 2/1000 live births, respectively, by 2007. • Expand National Disease Control Program and National Family Welfare Program to improve availability and utilization of healthcare services.

The government health system has a vast infrastructure of health centers and personnel in the rural areas of each state,[3] each comprised of several tiers.[3, 10, 11, 40, 76, 84] Primary Healthcare is composed of a network of primary healthcare centers, community

health centers, and sub-centers that provide necessary healthcare including family planning as well as reproductive and child health services.[3, 10, 11, 40, 76, 84] In addition, cadres of health workers, such as the Auxiliary Nurse Midwives (ANMs), provide outreach services.[3, 10, 11, 40, 76, 84] A local village based worker, called the "*Anganwadi* worker" offers preschool education, ANC services, and food supplements to pregnant women and children.[11] Referrals are made to District Hospitals and other public and private hospitals.[3]

India's health system is in a unique position today.[15] The country bears a large proportion of the world's health burden of the total childhood and maternal deaths around the world, 23% and 25%, respectively, occur in India.[17, 85] According to WHO estimates, in 1999, 35% of neonatal deaths occurred in South-East Asia and more than 90% of these deaths occurred in India, Bangladesh, Indonesia, Myanmar, and Nepal.[17] The Neonatal Mortality Rate for India in the year 2000 was 43/1,000 live births, early neonatal mortality rate was 33/1,000 live births, and the maternal mortality ratio was 540/100,000 live births.[17] The pervasiveness of inequalities resulting in poor maternal and child health in India merits particular attention.[16] Despite the extensive infrastructure, provision and utilization of healthcare services in rural India is poor.[3] Deficiencies in the function of health centers, attendance by health personnel, and availability of medical supplies are commonly reported thus rural areas remain underserved.[3] The rural primary healthcare infrastructure described above has been criticized as conceptually and theoretically sound but practically dysfunctional.[76] In addition to the government program, reproductive and child health services are also available through various non-governmental organizations, private providers, and healthcare facilities.[3, 11] Similarly, alternative and traditional

healthcare systems and providers are also widely utilized in rural communities.[11, 57, 76, 84, 86-93]

Uttar Pradesh

Uttar Pradesh (UP) state is one of the least developed regions of the country. UP is located in the north central part of India,[3] (Figure 1) in the foothills of the Himalayas and alluvial plains of the rivers Ganga, Ghaghara, and Yamuna. Though the land is fertile, some parts of the state are flood and drought prone. Hindi is the most widely spoken language (90%) and there are various unique dialects spoken in the 70 districts within the state.[94] Similarly, Hinduism is the prevailing religion. According to the National Family Health Survey-II, Uttar Pradesh (NFHS-II, UP), in 1998-99, 83% of UP's population was Hindu.[21] About 20% of the population is SC.[2] The society is predominantly rural (80%)[3, 21] with social classes comprising of landowners and those involved in cultivation.[3] The economy and industries are agricultural based, such as cotton mills, sugar mills, food grains, etc.[3] UP is one of the most socio-economically disadvantaged states in the country[3] because of relatively inferior technological advancements. In the 2003 general elections, the socialist party was elected and Chief Minister Mulayam Singh Yadav took the office with a promise to minimize poverty and discrimination.[95] Frequent changes in state governments and administrations have posed a challenge for sustained implementation of developmental policies and programs.[3]

UP is the fifth largest and most densely populated state in India[2, 18] (Table2). Population of UP is comparable to the population of Brazil.[2] At an annual growth rate of

Table 2. Demographic Characteristics – India, State of Uttar Pradesh (UP), Urban Population-UP, and Rural Population-UP

Indicators	India*	UP†	Urban Population –UP†	Rural Population –UP†
Population (in millions)	1028[2]	166[2]	34[2]	131[2]
Population-Scheduled Caste (%)	16.2[2]	21.1[2]	NA	N/A
Sex ratio (females/1000 males)	933[2]	927	925	927
Illiteracy among females (%)	48.6 (All SC: 73)	57.3[1]	33.9	63.8
Household using govt. health facilities (%)	28.7	N/A	N/A	N/A
MORTALITY AND FERTILITY RATES				
Maternal mortality ratio (deaths/100,000 live births)	540	N/A	N/A	N/A
Neonatal mortality rate	43.4 (53.2)	53.6	N/A	N/A
Post-neonatal mortality rate	24.2 (29.8)	33.1	N/A	N/A
Infant mortality rate	67.6 (83)	86.7 (100)[97]	N/A (73)[97]	N/A (104)[97]
Total fertility rate	2.85	3.99	2.88	4.31
SOCIOECONOMIC STATUS				
Per capita income (in Rupees)	14, 682 (Approx. US$294)	4,787 (Approx. US$96)[95]	N/A	N/A
Households with electricity (%)	60.1	36.6[1] or 21.9[66]	67.8[66]	11[66](11)[7]
Households with safe drinking water (%)	77.9	85.6[1] or 62.2[66]	85.8[66]	56.6[66]
Households with no toilet facilities (%)	64	73.3[1] or 82[66]	33[66]	94[66] (99)[7]
Low SES (%)	36.3	N/A	N/A	N/A
Medium SES (%)	44.3	N/A	N/A	N/A
High SES (%)	18.2	N/A	N/A	N/A
HEALTHCARE SERVICES UTILIZATION				
ANTENATAL CARE				
From a health professional (%)	65.1	N/A	N/A	N/A
Through home visit (%)	N/A (5.9)	3.2	1.3	3.6
From Doctor (%)	N/A	21.3	48.3	16.1
Received at least one ANC (%)	65.4	34.6[1]	N/A	N/A
Received ANC in first trimester (%)	33	16.9[1]	N/A	N/A
Received two or more TT injections (%)	66.8	51.4[1]	76.7	46.5
Received IFA tablets or syrup (%)	57.6	32.4[1]	52	28.6

N/A - Data Not Available. *The data source is NFHS-II, India,[1] unless otherwise indicated. †The data source is NFHS-II, UP,[21] unless otherwise indicated. Data in parentheses is for SC population

Table 2. (Continued) Demographic Characteristics – India, State of Uttar Pradesh (UP), Urban Population-UP, and Rural Population-UP

Indicators	India*	UP†	Urban Population –UP†	Rural Population –UP†
BIRTH ASSISTANCE AT HOME				
Assisted by a doctor (%)	N/A	2.9	6.5	2.2
Assisted by other health professionals (%)	42.3	4.4	8.5	3.6
Assisted by a traditional birth attendant (%)	35 (37.7)	34.4	35.2	29.9
POSTPARTUM CHECK-UP				
Within 2 months after birth (%)	16.5 (17)	N/A	N/A	N/A
CURRENT CONTRACEPTIVE USE				
Any modern method (%)	42.8	22	36.6	18.3
Pill (%)	2.1	1.2	2.3	1
Intra Uterine Device (%)	1.6	1	2.6	0.6
Condom (%)	3.1	4.2	12.6	2.1
Female sterilization (%)	34.2	14.9	18	14.1
Male sterilization (%)	1.9	0.7	1	0.6
Rhythm/safe period (%)	3	4.1	4.3	4
Withdrawal (%)	2	1.6	2.9	1.3

N/A - Data Not Available. *The data source is NFHS-II, India,[1] unless otherwise indicated. †The data source is NFHS-II, UP,[21] unless otherwise indicated. Data in parentheses is for SC population

2.3%, it is predicted that within this decade, UP's population will increase from 166 million to 174.6 million.[18] Such an increase will significantly fuel population growth for the whole country[96] and would compromise development efforts.[18] During 1992-96, the life expectancy at birth in UP was only 57 years, whereas the overall average of India was 61 years.[98] UP has the third highest child mortality rate in the country (UP: 46/1,000 live births, India: 33.4/1,000)[99] and the lowest immunization rates.[16] In 1998 when the infant mortality rate for India was 68/1,000, UP had an infant mortality rate of 86.7/1,000.[1] Neonatal and post-neonatal mortality rates in UP (53.6 and 33.1, respectively) are higher than all India average.[1] The maternal mortality ratio for UP is unknown. The fertility rate in UP especially rural UP exceeds the average for India.[1] National Family Health Survey-I, 1992-93 (NFHS-I) showed that the status of maternal health in this state was dismal relative to most of India.[100] ANC utilization, TT, and IFA receipt in UP and among the rural population is poorer compared to rest of the country.[1] Level of utilization of government health facilities in UP is not known. UP has the lowest current contraceptive adoption (19.8%).[101] Female sterilization is the preferred contraceptive method[101] among currently married women[1, 18] because in north India if a couple has only surviving daughter(s) and no surviving son(s), the couple does not use contraceptives until they have desired number of living son(s).[18] Among the rural SC population in UP the infant mortality rate is 104/1,000 (males: 101/1,000 and females: 106/1,000)[97] which is much higher when compared to the all India average. Data for other health indicators for the SC population of UP are not available. Socio-demographic and other health indicators for the SC population in India show that SC population fair poorly when compared to the rest of the country.[1]

A significant proportion of UP's population is poor (as indicated by proportion of households with electricity, water, and toilet facilities)[1] and SC[2] (Table 2). SC are especially poor; 99% of SC households do not have toilet facilities.[7] Women in UP are acutely disadvantaged.[3, 4, 41] The United Nation Development Program's Gender Disparity Index ranked UP 31 out of 32 states.[3] Unequal female to male sex ratio (927:1000)[1] and illiteracy among SC (73%)[1] and rural women (64%)[1] are indicators of caste and gender inequalities in UP.

As described above, compared to the other states of India, UP fairs poorly on demographic and healthcare outcomes.[3, 15, 99] Furthermore, people in rural regions, women, and the SC population in UP fair even more poorly. The difference in social conditions between different states and between the different communities in each state is precipitated by the strong emphasis on caste affiliation.[10, 11] This highlights the need for state level policy formulation that addresses such conditions.[10, 11]

In the given social context, the goal of this dissertation research was to explore whether caste is a determinant of maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization among Hindu women and neonates in UP, India.

Review of the Literature

To achieve the goal of the dissertation research, available literature was searched. The purpose of the literature review was to identify studies that had examined an associa-

tion between caste and maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization.

The literature review was undertaken during January 2005 to March 2007. The search strategy included both published and unpublished documents. Reports, documents, and studies pertaining to safe motherhood, newborn care, child survival, and healthcare disparities in developing and developed world were reviewed. 'Maternal and neonatal health inequalities in Asia' was identified as the broad area of interest. Later, research studies were searched through review articles, peer reviewed journals, bibliographies of retrieved articles, university libraries, and electronic databases. The topic of interest was further narrowed down to 'determinants of unequal utilization of maternal healthcare services and neonatal care as well as neonatal healthcare services in Asia'. The initial review of the literature helped to identify five broad components of maternal healthcare; ANC, labor and delivery care, postpartum care, contraceptive use, and emergency care, as well as three components of neonatal care, umbilical cord care, routine care, and emergency care.

Review of the titles and abstracts of the articles helped to determine the inclusion and exclusion criteria to streamline the search. The inclusion and exclusion criteria are described below.

The focus of inquiry was to identify whether caste is a barrier to maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization. Initially all studies irrespective of the study design and sample size were considered for inclusion. However, reports, editorials, letters, and non-scientific documents were eliminated. Peer reviewed articles, randomized controlled studies, meta-analysis studies,

and review articles were included. Cross-sectional, longitudinal (prospective and retrospective), case-control, ethnographic, and anthropological studies as well as surveys were included. All types of research methodologies and sample sizes were included. The initial review revealed that the studies prior to 1980 had used data from 1970s or earlier therefore studies that were published after 1979 till date and that had used data from the same time period were included. Studies prior to 1980 were excluded. Only studies published in English language and dealing with human subjects were considered. To access studies dealing with utilization of maternal healthcare services the age limit was set at 'all adults (19+ years)' and 'females'.

The initial review showed that very few studies on neonatal health were available, hence inclusion criteria for utilization of neonatal/child healthcare services was broadened to include study participants up to 72 months old of both genders.

Two terms 'caste' and 'kinship group' indicate the caste affiliation of the individual therefore both terms were included. The terms, 'utilization' and 'access to care' were found to be used interchangeably in the literature therefore, studies examining both were included. Access to or utilization of maternal healthcare services was restricted to ANC, ANC timing and frequency, IFA intake, TT intake, assistance at birth, place of delivery, PPC, utilization of healthcare facility/provider in case of emergency, and postpartum contraceptive use. Neonatal/child healthcare services such as umbilical cord care, hospitalization, health facility type, provider type, physician consultation, neonatal check-up, referrals, and medication were included.

The initial literature search indicated that besides caste, SES and gender/sex composition of living children were other two major determinants of utilization of maternal

and child healthcare services in India and South-East Asia. The scope of literature review was expanded to include studies that had examined an association between SES and gender/sex composition of living children with respect to the utilization of components of maternal and neonatal healthcare services that are described above. The inclusion/exclusion criteria and limits for literature search were updated to identify new studies. Terms such as 'Standard of Living Index', 'SES', 'household wealth', 'family income', and 'possession of durables' indicate the composite SES of the family, thus studies using any of these terms were included. Terms, 'total number of living sons' and 'sex/gender composition of living children/siblings' were included. Both maternal literacy and educational level were also taken into consideration. Since both caste and gender discrimination are widespread in all regions/states of India, Nepal, and Bhutan, studies from these countries were included. Gender discrimination is prevalent in other neighboring countries; therefore studies from the Indian sub-continent (Bangladesh, Bhutan, Nepal, and Pakistan) were also included. Studies from both rural and urban sites were included.

After determining the above mentioned inclusion and exclusion criteria peer reviewed articles were searched for in electronic databases (Pub Med and Economic and Political Weekly) using the combination of following search terms, 'caste', 'kinship group', 'socioeconomic status', 'standard of living', 'gender', 'sex composition of surviving children', 'maternal literacy/education', 'health', 'health services', 'access to healthcare', 'utilization of healthcare', 'maternal healthcare', 'newborn', 'neonatal', 'neonatal/newborn healthcare', 'umbilical cord care', 'child healthcare', 'India', 'Pakistan',

'Bhutan', 'Nepal', 'Bangladesh', etc. Related links to relevant articles and bibliographies of the retrieved articles were also accessed.

When the inclusion and exclusion criteria were applied, no review articles were found but 145 studies were found of which twenty-nine peer-reviewed studies met one or more of the above mentioned inclusion/exclusion criteria. Flow charts in figure 2 and 3 summarize the literature search processes for utilization of maternal and neonatal/child healthcare services, respectively.

Twenty-nine studies relevant to this study were thoroughly and systematically reviewed. Data from these studies were extracted and later organized into groups based on similarities of study objectives. Study results were tabulated under two primary categories: a) maternal healthcare services utilization, and b) neonatal care as well as neonatal healthcare services utilization. Various components of maternal and neonatal healthcare such as ANC, TT, IFA, PPC, routine NNC, etc., were studied in chronological order of pregnancy and severity of the health condition (routine care followed by emergency care/treatment outside home). Tabulated data in each section were subcategorized into three primary determinants of healthcare utilization: caste, SES, and sex composition of living children/siblings.

Determinants of Maternal Healthcare Services Utilization

Data from northern[11] and southern[10, 22, 102, 103] states showed that SC[10, 11, 22, 102, 103] or lower caste[31] women had poorer utilization of ANC[10, 11, 22, 31] (Odds Ratio (OR)=0.7, $p<0.05$)[10, 11, 22, 31] at healthcare facilities and via home visits,[11] late ANC[22] (OR=0.6,

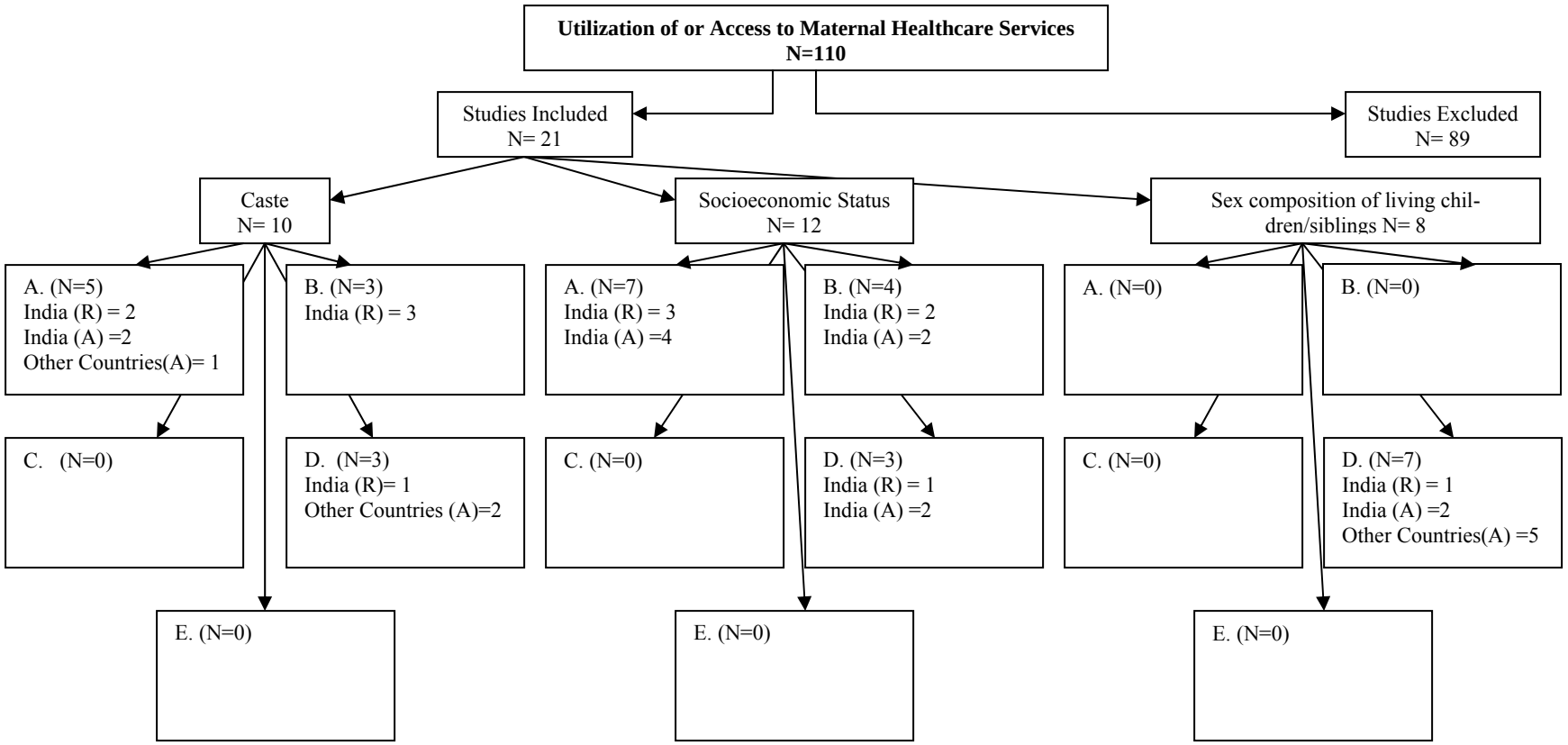

Figure 2. Flow Chart Depicting Literature Search Process for Maternal Healthcare Services

Components of Maternal Healthcare: A= Antenatal Care/Tetanus Toxoid/Iron Folic Acid, B=Attendance at Birth/Intrapartum Care, C=Postpartum Care, D=Contraceptive Use, E=Referral/Emergency Care
Type of Study Sites: R=Rural Sites, A=Any Site
Some studies addressed more than one determinant and component of maternal healthcare, therefore the sub-totals do not equal grand total. Excluded studies did not meet the inclusion criteria.

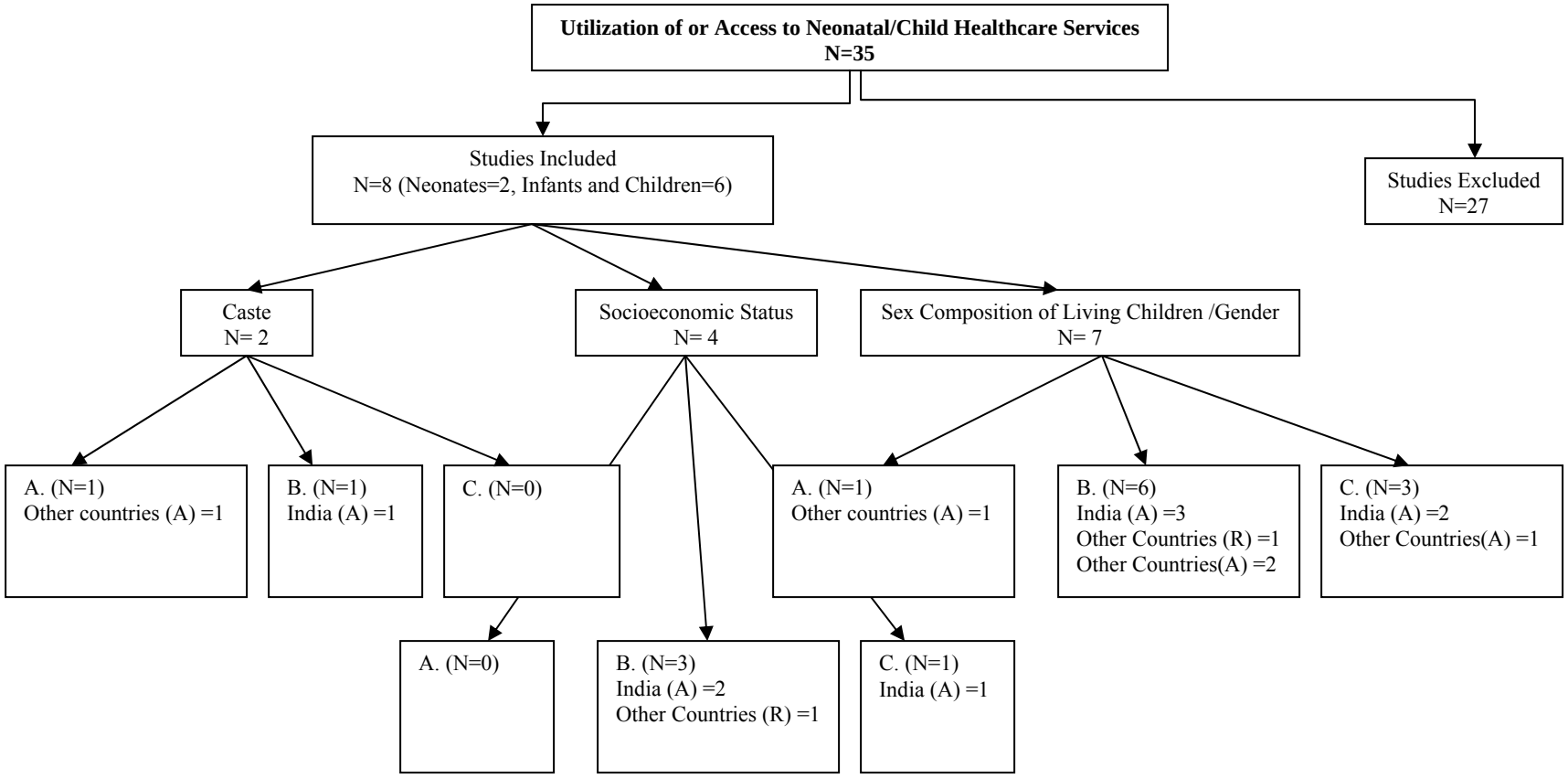

Figure 3. Flow Chart Depicting Literature Search Process for Neonatal/Child Healthcare Services

Components of Neonatal/Child Healthcare: A=Umbilical Cord Care, B=Routine Neonatal Care, C=Referral/Emergency Care
Type of Study Sites: R=Rural Sites, A=Any Site
Some studies addressed more than one determinant and component of neonatal healthcare, therefore the sub-totals do not equal grand total. Excluded studies did not meet the inclusion criteria

$p<0.05$)[10, 22] visits, poorer quality ANC,[102] lower utilization of IFA (upper caste women compared to SC women had higher odds OR=1.3, $p<0.05$),[11] as well as lower odds of professional attendance at birth[103, 104] (OR=0.52, $p<0.01$)[10, 103] (Table 3). A study from Nepal showed that level of ANC utilization varied between upper caste (mean: 10.42, Standard Deviation (SD): 2.98) and lower caste (mean: 7.89, SD: 2.27) women, $p<0.01$.[31]

A study[6] from rural Bihar, India showed statistically significant association between caste and utilization of female sterilization; compared to upper caste women, lower caste women were less likely to utilize female sterilization (OR=0.49, $p<0.05$) (Table 3). Studies from Nepal[34, 35] showed lower prevalence of contraceptives among lower caste women.

High[10, 11, 22, 40, 99, 102, 103, 105, 106] or medium[10, 40, 102] SES (as measured by the standard of living,[10, 11] house type,[105] possession of wealth,[22, 103] or employment type[103]) was found to be significantly associated with comprehensive[10, 11, 105] and adequate ANC[102, 106] (OR=3.4, $p<0.01$),[10, 102, 106] choice of private provider (OR=2.62, $p<0.001$),[40] higher utilization of IFA (OR=1.3, $p<0.01$)[11] and TT (OR=1.63, $p<0.05$),[10] and professional attendance at birth[10, 99, 104] (OR=4.34, $p<0.01$)[10, 99] (Table 3). Data from all recent studies (ecological,[10, 11] prospective,[22, 102, 103] cross-sectional[40, 99, 105, 106]) except one[22] (where the relative risk is not known), indicated a positive association between SES and utilization of maternal healthcare services.

Two studies[18, 106] from UP, India showed that contraceptive utilization improved with higher SES. However, despite large samples, the results were of borderline significance (OR=1.3, 95% Confidence Interval (CI): 1.1, 1.5) (Table 3). Nonetheless, a statistically significant association between SES and utilization of female sterilization[6] is evide-

Table 3. Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
CASTE			
Pallikadavath et al. (2004)[11]	Ecological data analyses, NFHS-II (1998-99)	N=11,369 Ever married women in the reproductive age group from UP, Rajasthan, Bihar, and Madhya Pradesh (rural sites), India	• In Rajasthan, upper caste women were 0.7 times less likely ($p<0.05$) to receive ANC via home visits than SC women. • In UP caste membership did not influence ANC utilization. • Scheduled Tribe women were 1.3 times more likely ($p<0.05$) to receive IFA than SC women. • Other caste women were 0.7 times less likely ($p<0.05$) to receive TT compared to SC women.
Navaneetham et al. (2002)[10]	Ecological data analyses, NFHS-I (1992-93)	N=6,522 Ever married women in the reproductive age group from Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu, India	• In Andhra Pradesh, SC women were 30% less likely ($p<0.05$) to receive ANC compared to non-SC women. • In Karnataka, SC women were 40% less likely ($p<0.01$) to receive ANC in first trimester compared to non-SC women. • In Karnataka, Kerala, and Tamil Nadu, SC women were less likely (OR= 0.52, $p<0.01$, OR=0.36, $p<0.05$, and OR=0.73, $p<0.10$, respectively) to be attended by a health professional during delivery compared to non-SC women. • SC women in Karnataka, Kerala, and Tamil Nadu, were less likely than non-SC women to deliver in healthcare institutions. • Caste affiliation did not make any significant difference in receiving 'adequate ANC' and TT.
Matthews et al. (2001)[22]	Prospective population-based study (1996 -98)	N= 282 Pregnant women from rural Karnataka, India	• 57% Gowda caste women, 61% Lingayat caste women, 52% SC or scheduled tribe women, 39% Lambani tribe women, and 62% OBC women sought antenatal care in the first trimester $p<0.01$.
Acharya et al. (2004)[31]	Cross-sectional survey	N=215 Third trimester women from Pokhra, Nepal	• Upper caste (mean: 10.42, SD: 2.98), Newar (mean: 9.60, SD: 3.11), and lower caste (mean: 7.89, SD: 2.27) women received different levels of ANC ($F = 4.53$, $p<0.01$)
Chandrashekar et al. (1998)[102]	Prospective cohort study (1991-93)	N=12, 857 Live births among women from Kanara, Karnataka, India	• Lower number of SC women (32%) received good quality ANC compared to caste Hindus (55%) ($\chi^2 = 519$).

Table 3. (Continued) Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
CASTE (Continued)			
Matthews et al. (2005)[103]	Prospective population-based study (1996-98)	N=388 Pregnant and postpartum women from rural Karnataka, India	• Those planning to deliver either at an institution or at home with ANMs assistance tended to be of higher caste ($p<0.05$). • SC or scheduled tribe women were 0.29 times less likely to intent to deliver at home with ANMs assistance compared to Gowda women ($p<0.05$).
Ram et al. (2006)[104]	Cross-sectional survey	N=11,454 Women who given birth to 1 child after 1998 in UP, India	• Upper caste women were more likely to be assisted by trained professional at birth (OR=1.22, $p<0.10$) and to deliver at hospital (OR=1.70, $p<0.05$) compared to SC or scheduled tribe women. • OBC women were more likely to deliver at hospital (OR=1.33, $p<0.05$) compared to SC or scheduled tribe women.
Thind et al. (2005)[6]	Ecological data analyses for rural Bihar, NFHS-II (1998-99)	N=1,378 Ever-married women (15-49 yrs) currently using contraceptives in rural Bihar, India	• SC women were 0.49 times ($p<0.05$) less likely to use female sterilization than upper caste women.
Schuler et al. (1985)[35]	Anthropological study (1982)	3 pairs of simulated clients at 16 family planning clinics in Katmandu, Nepal	• Intra Uterine Devices and other temporary methods are rarely recommended to low caste clients, whereas, sterilization is highly recommended.
Ross et al. (1986)[34]	Anthropological survey	N= 1,231 Currently married women (15-49 yrs old) in Katmandu, Nepal	• Overall contraceptive prevalence was 0.50 among urban upper caste women, 0.368 among rural upper caste women, and 0.31among lower caste women.
SOCIOECONOMIC STATUS			
Pallikadavath et al. (2004)[11]	Ecological data analyses, NFHS-II (1998-99)	N=11,369 Ever married women in the reproductive age group from UP, Rajasthan, Bihar, and Madhya Pradesh (rural sites), India	• In UP, women who had higher 'Standard of living' were 1.2 times ($p<0.01$) more likely to receive ANC compared to women who had lower 'Standard of living'. • Women who had higher 'Standard of living' were 1.3 times ($p<0.01$) more likely to receive IFA compared to women who had lower 'Standard of living'. • Women who had higher 'Standard of living' were more likely to receive ANC components such as tests or medicines.

Table 3. (Continued) Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
SOCIOECONOMIC STATUS (Continued)			
Navaneetham et al. (2002)[10]	Ecological data analyses, NFHS-I (1992-93)	N=6,522 Ever married women in the reproductive age group from Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu, India	• In Karnataka, women who had higher and medium 'Standard of living', were 1.48 ($p<0.01$) and 2.07 ($p<0.05$) times, respectively, more likely to receive ANC compared to women who had lower 'Standard of living'. • In Tamil Nadu, women who had higher 'Standard of living' were 3.4 times ($p<0.01$) more likely to receive 'adequate care' compared to women who had lower 'Standard of living'. • In Kerala, women who had medium 'Standard of living' were 1.51 times ($p<0.05$) more likely to receive ANC in first trimester compared to women who had lower 'Standard of living'. • In Karnataka and Tamil Nadu, women who had medium 'Standard of living' were 1.36 and 1.63 ($p<0.05$) times more likely to receive TT compared to women who had lower 'Standard of living'. • In Andhra Pradesh and Karnataka, women who had higher 'Standard of living' were 3.75 times and 4.34 times ($p<0.01$), respectively, more likely to be attended by health professionals during birth compared to women who had lower 'Standard of living'. • In Kerala women who had medium 'Standard of living' were 1.95 times ($p<0.01$) and in Tamil Nadu women who had higher 'Standard of living' were 3.43 times ($p<0.05$) more likely to be attended by health professionals compared to women who had lower 'Standard of living'.
Nielsen et al. (2001)[105]	Cross-sectional study (1995)	N=1,320 Women who had recently delivered from rural Tamil Nadu, India	• Women who lived in *pucca* houses were 1.4 (CI: 1.1, 1.8) times more likely to receive 5+ ANC visits compared to women who lived in *kutcha* houses. • Ownership of house and land were insignificantly associated with high ANC uptake.
Stephenson et al. (2002)[106]	Cross-sectional survey (1995-96)	N=3,109 Women 13-49 year who gave birth in 3 yrs prior to survey in UP, India	• SES had a significant and positive relationship with ANC utilization (OR=0.21, p=0.05). • SES was significantly and positively associated with contraceptive use (OR= 0.14, p=0.05).

Table 3. (Continued) Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
SOCIOECONOMIC STATUS (Continued)			
Bhatia et al. (1995)[40]	Cross-sectional survey (1993)	N=3,595 Currently married women under 35 yrs with at least 1 child < 5yrs from rural and urban Karnataka, India	• Middle and high SES women were 1.59 and 2.62 times, respectively, ($p<0.001$) more likely to seek private ANC providers compared to low SES women.
Bloom et al. (1999)[99]	Retrospective population–based cross-sectional survey (1995-96)	N=300 Poor to middle income Hindu or Muslim women who had delivered a child within past 3yrs from Varanasi, UP, India	• High SES women were more likely (OR=2.21, 95% CI: 1.15-4.23, $p<0.001$) to be attended by trained personnel.
Matthews et al. (2001)[22]	Prospective study (1996-98)	N= 282 Pregnant women from rural Karnataka, India	• Wealth did not have a marked effect – except for the very wealthy – on ANC utilization during the first trimester.
Chandrashekar et al. (1998)[102]	Prospective cohort study (1991-93)	N=12, 857 Live births in Kanara, Karnataka, India	• Lower SES women were 4.97 (CI: 3.82, 6.46) times more likely to not utilize ANC compared to upper and middle SES women.
Matthews et al. (2005)[103]	Prospective population-based study (1996 -98)	N=388 Pregnant and postpartum women from rural Karnataka, India	• Those planning to deliver either at an institution or at home with ANMs assistance tended to be higher SES ($p<0.05$). • Women whose household possession ranged between Rs.5001-15,000 were 3.70 times ($p<0.05$) and whose possessions exceeded Rs.15, 001 were 5.43 times ($p<0.05$) more likely to intend to deliver at an institution compared to women whose possession were less than Rs.1000. • Women whose husbands were salaried were much more likely to plan a hospital birth or an ANM-assisted delivery. • Families with extensive lands and livestock were very similar to the landless families in their delivery intentions.

Table 3. (Continued) Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
SOCIOECONOMIC STATUS (Continued)			
Ram et al. (2006)[104]	Cross-sectional survey	N=11,454 Women who given birth to 1 child after 1998 in UP, India	• High SES women were more likely to be assisted by trained professional at birth (OR=1.74, p<0.10) and to deliver at hospital (OR=2.30, p<0.05) compared to low SES women. • Medium SES women were more likely to be assisted by trained professional at birth (OR=1.26, p<0.10) and to deliver at hospital (OR=1.41, p<0.05) compared to low SES women.
Thind et al. (2005)[6]	Ecological data analyses for rural Bihar, NFHS-II (1998-99)	N=1,378 Ever-married women (15-49 yrs) currently using contraceptives in rural Bihar, India	• Women who had a high standard of living were 0.60 times (p<0.10) less likely to use female sterilization than women who had low standard of living.
Dwivedi et al. (2000)[18]	Ecological data analyses for UP, NFHS-I (1992-93)	N=7,851 Married women in reproductive age group with at least 1 child, currently not pregnant or practicing postpartum amenorrhea in UP, India	• Women who lived in *pucca* houses were more likely to adopt contraception (OR = 1.3; CI: 1.1-1.5).
SEX COMPOSITION OF LIVING CHILDREN			
Thind et al. (2005)[6]	Ecological data analyses for rural Bihar, NFHS-II (1998-99)	N=1,378 Ever-married women (15-49 yrs) currently using contraceptives in rural Bihar, India	• Women who had ≥ 2 living sons were 2.77 times (p<0.001) more likely to use female sterilization than women who had no or only one living son.

Table 3. (Continued) Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
SEX COMPOSITION OF LIVING CHILDREN(Continued)			
Dwivedi et al. (2000)[18]	Ecological data analyses for UP, NFHS-I (1992-93)	N =7,851 Married women in reproductive age group with at least 1 child, currently not pregnant or practicing postpartum amenorrhea in UP, India	• Contraceptive adoption was positively associated with the number of living sons and number of ever born male children. • Women who had ≥ 2 living sons were more likely to adopt contraception (RR = 2.2; CI: 1.1-4.4). • Women who had 1 living son were 4.69 times (CI: 3.38-6.52, adjusted RR = 1.30, CI: 0.66-2.52), women who had 2 living sons were 9.70 times (CI: 7.13-13.23, adjusted RR = 2.20, CI: 1.06-4.40), and women who had ≥ 3 living sons were 14.54 times (CI: 10.80-19.63, adjusted RR = 4.10, CI: 2.00-8.60) more likely to use contraceptives compared to women who had no living sons. • Women who ever had born 1 son were 5.16 times (CI: 3.54-7.52, adjusted RR = 3.10, CI: 1.50-6.4), women who ever had born 2 sons were 11.65 times (CI: 8.19-16.57, adjusted RR = 4.10, CI: 1.90-9.1), women who ever had born 3 sons were 18.10 times (CI: 12.80-25.61, adjusted RR = 4.80, CI: 2.10-10.6), and women who ever had born ≥ 4 sons were 15.15 times (CI: 10.75-21.36, adjusted RR = 3.80, CI: 1.70-8.7) times were more likely to use contraceptives compared to women who have never born a son.
Bairagi et al. (2001)[107]	Longitudinal surveillance data (1980s & 90s)	N=10,000 to 18,000. Married women of childbearing age in Matlab, Bangladesh	• Contraceptive use increased with the number of sons; however, it stabilized or decreased among those who had at least two sons.
Chowdhury et al. (1993)[108]	Longitudinal surveillance data (1977 & 84)	N=2,111 & 3,140. Married women of childbearing age in Matlab, Bangladesh	• Higher number of sons was associated with a higher percentage of women currently using contraception.
Niraula et al. (1995)[5]	Anthropological survey (1988)	N=719 Women aged 15-54 years in Benighat, Nepal	• The odds of using contraception rose with number of living sons but results were statistically insignificant
Morgan et al. (1995)[32]	Anthropological survey (1993)	N= 3,826 Benighat and Baghi, Nepal	• Women with at least one sons were two to three times more likely to use contraception than those with no sons

Table 3. (Continued) Determinants of Maternal Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Sample Size and Target Population	Results
SEX COMPOSITION OF LIVING CHILDREN(Continued)			
Chacko (2001)[9]	Cross-sectional survey and ethnographic study (1991-95)	N=600 married women (15-46 yrs old) in Kultali, West Bengal, India	• Total number of living sons was significantly associated with woman's contraceptive use ($p<0.001$).
Stash (1996)[36]	Prospective study (1993-94)	N=769 married couples in Nepal	• 22% couples with one living son have been sterilized, whereas 49% of couples with two living sons have been sterilized.

-nt.

Studies from UP,[18] rural West Bengal,[9] and rural Bihar[6] in India, and Nepal[36] showed that the probability of any contraceptive use,[9, 18] including both male[36] and female sterilization,[6] significantly increased with the increase in number of living sons (Table 3). Two studies from Bangladesh also showed similar results.[107, 108] However, one study[5] from Nepal showed a statistically insignificant association, and in another study[32] statistical significance was not known. The likelihood of contraceptive use increased with the number of living sons.[18] Women who had 2 living sons were twice as likely (OR=2.20, 95% CI: 1.1, 4.4) to use contraceptives compared to women who had no living sons.[18] Also, women who had 3 living sons were almost five times as likely (OR=4.80, 95% CI: 2.10, 10.6) to use contraceptives compared to women who have ever born a son.[18] Furthermore, Dwivedi et al.,[18] and Thind et al.,[6] found that both SES and number of living sons were significantly associated with contraceptive utilization.

Determinants of Neonatal Care and Healthcare Services Utilization

Since neonatal health is not an extensively researched area, no studies could be found that examined an association between caste and neonatal care or utilization of neonatal healthcare services in India. However, in one study Berman et al.,[109] noted that SC families had a greater demand for child (<6 years old) healthcare services. In another study from Nepal it was found that other caste neonates were 30% more likely to get umbilical cord infection than the *Brahmin*/*Chhetri* (upper caste) neonates, p=0.02.[48]

Ahmed et al.,[110] and Berman et al.,[109] reported that an increase in household income was positively associated with a greater expenditure on child[109] and neonatal[110] healthcare (OR=2.54, 95% CI: 1.08, 5.97)[110] (Table 4). However, Pillai et al.,[64] and Bhan et al.,[56] reported contradictory findings.

Compared to daughters, sons were more likely to receive curative[109] healthcare from private practitioners,[65] physicians[70, 110, 111] (OR=2.04, 95% CI: 1.29, 3.22),[70, 110, 111] traditional practitioners,[110, 111] from more than one healthcare provider,[111] and at hospitals[56, 111] (Table 4). Even providers were more likely to advise referral if the sick child was male;[65] parents were also more likely to purchase drugs for sons.[70] Although Pillai et al.,[64] reports an insignificant association between a child's gender and healthcare utilization, female children were significantly less likely to receive care from alternative providers.

Summary of the Findings of the Literature Review

We found only ten studies that had data on caste and utilization of maternal and neonatal/child healthcare services. These studies indicated a positive association between caste and utilization of maternal healthcare services. Lower caste women were reported to be less likely to utilize almost all components of maternal healthcare, such as ANC, IFA, trained birth attendant, and contraceptives compared to upper caste women. Results were statistically significant. The ecological studies[10, 11] showed no association between caste membership and ANC and TT utilization;[10, 11] mixed results were also reported[11] (Table 3).

Table 4. Determinants of Neonatal Care and Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Target Population and Sample Size	Results
CASTE			
Berman et al. (1997)[109]	Prospective cohort (1989-90)	N=276 Low income household with children <6 yrs in Haryana, India	• Both SC and OBC families appear to have a greater demand for child healthcare services, after controlling for income, assets, and other household factors.
Mullany et al. (2006)[48]	Cluster-randomized trial (2002-05)	N=17,198 Newborns born during Sept. 2002-Mar. 2005 in Nepal	• Other caste neonates were 30% (OR=1.30, CI: 1.05-1.60, p<0.05) more likely to get umbilical cord infection compared to the *Brahmin/Chettri* (upper) caste neonates.
SOCIOECONOMIC STATUS			
Berman et al. (1997)[109]	Prospective cohort (1989-90)	N=276 Low income household with children <6yrs in Haryana, India	• Increase in household income was positively linked to greater expenditures on child healthcare.
Ahmed et al. (2001)[110]	Cross-sectional survey (1996-98)	N=1,511 Women who had live births in rural Bangladesh	• Families with a monthly expenditure of Tk.4000 or more were more likely to seek care for their newborns than families with a monthly expenditure of less than Tk.2000 (OR=2.54, CI: 1.08-5.97).
Bhan et al. (2005)[56]	Randomized control trial and 1yr follow-up (2002-03)	N=85,633 Middle or low-income children (1-23 months) from New Delhi, India	• Economic status was not found to affect the association of gender and hospitalization, though overall odds of hospitalization were higher for children in the higher economic stratum, than in the middle or lower strata.
Pillai et al. (2003)[64]	Ecological data analyses for Kerala, NFHS II (1996).	N=469 Children (<4yrs) who had at least 1 symptom of acute respiratory infection or diarrhea during 2 weeks preceding the interview in Kerala, India	• Higher SES children were more likely not to receive medical care (OR=2.35, CI: 1.05-5.25, p<0.05).
GENDER/SEX COMPOSITION OF LIVING SIBLINGS			
Berman et al. (1997)[109]	Prospective cohort (1989-90)	N=276 Low income household with children <6 yrs in Haryana, India	• Boys were 2.16 times more likely to seek curative healthcare.

Table 4 (Continued) Determinants of Neonatal Care and Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Target Population and Sample Size	Results
GENDER/SEX COMPOSITION OF LIVING SIBLINGS (Continued)			
Mullany et al. (2006)[48]	Cluster-randomized trial (2002-05)	N=17,198 Newborns born during Sept. 2002-Mar. 2005 in Nepal	• Female neonates were as likely to get umbilical cord infection as male neonates.
Ganatra et al. (1994)[65]	Cross-sectional survey (1991)	N=3,100 Children <5 yrs in Pune, Maharashtra, India	• After controlling for severity and type of illness and other factors like parents' education, occupation and income, the chance of seeking medical advice from a private practitioner was 2.5 times greater for boys than for girls. • If referral for further treatment was advised it was 6.8 times more likely to be availed for sons than daughters.
Hossain et al. (1988)[70]	Cross-sectional survey (1980)	N=28,660 Children <5 yrs in Matlab, Bangladesh	• The male to female incidence rate ratio was 1.71 (CI: 1.27, 2.28) for overall drug purchase and 2.94 (CI: 1.14, 7.73) for purchase of drugs prescribed by physicians. • Physicians were consulted almost 3 times as frequently for male as for female children.
Fauveau et al. (1991)[111]	Surveillance data (1986-87)	N=47,000 Children 1-4 yr old in Matlab, Bangladesh	• Female children visited hospital significantly less often than male children. • The difference in the proportions of male and female children seen by a qualified physician was significant (30.2% versus 24.6%, Z=1.6, p=0.05) and a greater proportion of male than female children were seen by a traditional practitioner prior to death (19.7% versus 13.2%, Z=2.2, p=0.01). • A significantly greater proportion of male children were seen by more than one healthcare provider (38.6% versus 25.8%, Z=3.5, p<0.01)
Ahmed et al. (2001)[110]	Cross-sectional survey (1996-98)	N=1,511 Women who had live births in rural Bangladesh	• Care sought from the trained providers was 7% higher for male neonates compared to female neonates (OR=2.04, CI: 1.29, 3.22, p<0.01). • Care from any provider other than the herbalist/spiritual healer was sought for a greater proportion of male neonates. • Gender of the neonate (OR=1.13, CI: 0.91, 1.40) had insignificant association with neonatal morbidity.

Table 4 (Continued) Determinants of Neonatal Care and Healthcare Services Utilization in India, Nepal, and Bangladesh

Author	Study Design and Year	Target Population and Sample Size	Results
GENDER/SEX COMPOSITION OF LIVING SIBLINGS (Continued)			
Bhan et al. (2005)[56]	Randomized control trial and 1yr follow-up (2002-03)	N=85,633 Middle or low-income children (1-23 months) from New Delhi, India	• Female children (35.4%) were hospitalized far less frequently than male children (64.6%), p<0.001.
Pillai et al. (2003)[64]	Ecological data analyses for Kerala NFHS II (1996)	N=469 Children (<4yrs) who had at least 1 symptom of acute respiratory infection or diarrhea in Kerala, India	• Child's gender was not significantly associated with healthcare utilization, however, female children were significantly less likely to receive care from alternative providers (OR=0.39, CI: 0.20-0.77, p<0.01).

Mixed and inconclusive results could be attributed to regional variations in caste-based population composition and discrimination patterns, bias stemming from the categorization[10, 11, 102] of the study population into various caste groups which was not uniform across studies, or information bias stemming from interviewee-reported data on caste status. While relative risk was known from ecological[10, 11] and population-based prospective studies,[103] relative risk from other studies was not known (Table 3).

Very few studies were available to determine an association between caste and contraceptive utilization. Probably caste is associated with the utilization of reversible contraceptive methods. No studies were available to examine an association between caste affiliation and visit to a healthcare provider or treatment outside home and postpartum care.

From the reviewed literature other key barriers to utilization of MCH care services such as SES, sex composition of living children, and gender of the child were also identified. SES was found to be a key determinant of utilization of maternal healthcare services. An interesting observation was made by Bhatia et al.,[40] while comparing the choice of providers, he found that subsidized ANC services provided at government-run facilities were most likely utilized by women from all SES groups (Table 3). Economically advantaged women not only over-utilized services, but also competed with poor women for subsidized services. A few limitations of these studies emerged. Bloom et al.,[99] collected data from a poor and middle SES community and Chandrashekar et al.,[102] did not stratify the data by residence (rural and urban), therefore results from these two studies need to be examined with caution. No studies were available to examine an association between the SES of women and PPC.

Literature on sex composition of living children/siblings in a household and utilization of maternal healthcare services was limited to the utilization of contraceptives; other components of maternal healthcare services were not studied. The likelihood of contraceptive use increased with the total number of surviving sons a couple had (Table 3).

Several authors had indicated poorer utilization of maternal healthcare services in their analyses, not only by SC women, but also by low SES women.[11, 10, 22, 103, 102] No studies were available to examine the combined effect of caste, SES, and number of living sons on utilization of maternal healthcare services.

From the available literature not much is known about neonatal care and the utilization of neonatal healthcare services. The association between SES, child's gender and utilization of healthcare is most likely positive. Male children were more likely to receive all forms of healthcare services compared to female children. Whether such an association exists for neonates is not known. The association between caste and utilization of neonatal or child healthcare services is also not known.

No studies were available to simultaneously examine socioeconomic, gender, and caste differentials within a region/population.[7, 16] In conclusion, studies from India and the neighboring countries show that despite the availability of MCH services, access and utilization of these services is very poor among lower caste groups and other marginalized groups of the society. Previous research has also demonstrated that the factors deterring healthcare services utilization are not limited to the characteristics of the services and service providers, but often extended to the characteristics of the users such as their caste, SES, or gender.[39]

There is a need to study how poor SC women fair against wealthy SC women or rich upper caste women. It is likely that lower caste status predisposes an individual to poverty and eventually leads to unequal utilization of healthcare services. It is also pertinent to examine how lower caste, lower SES, and a fewer number of living sons impact utilization of maternal healthcare services. Thind et al.,[6] suggest that more research is needed to understand contraceptive use patterns among lower caste and lower SES women. This study was designed to fill such research gaps in maternal and neonatal healthcare research. The goal of the study was to explore if caste is a determinant of maternal healthcare services utilization among Hindu women and if caste is a determinant of neonatal care as well as neonatal healthcare services utilization among Hindu neonates in India.

RESEARCH QUESTIONS AND HYPOTHESES

Conceptual Framework

Healthcare services utilization is determined by a complexity of interacting factors.[43, 64, 112] It involves the personal characteristics of the user, the availability of services, acceptability and affordability of services, and also the social structure of the population.[43, 113-116] A conceptual model that has dominated healthcare services utilization studies in north America is that proposed by Aday and Andersen.[64, 117, 118] This multidimensional comprehensive model was initially developed to explain and predict the use of formal healthcare services.[117, 118] The model was developed to understand the "how's" and "why's" of health service utilization.[117] The original model[117] (Figure 4) focused on the family as the unit of analysis on the premise that the medical care an individual receives is a function of the demographic, social, and economic characteristics of the family as a unit.[117] The heterogeneous nature of family unit was thought to explain the health utilization behavior of individual family members.[117]

Traditional Indian societies do not acknowledge individual identity. Individuals in a family are considered to be a part of the whole family; their identity is a representation of the family they belong to. Given this the behavior of an individual is defined and determined by the family the individual belongs to. In traditional rural societies of India the

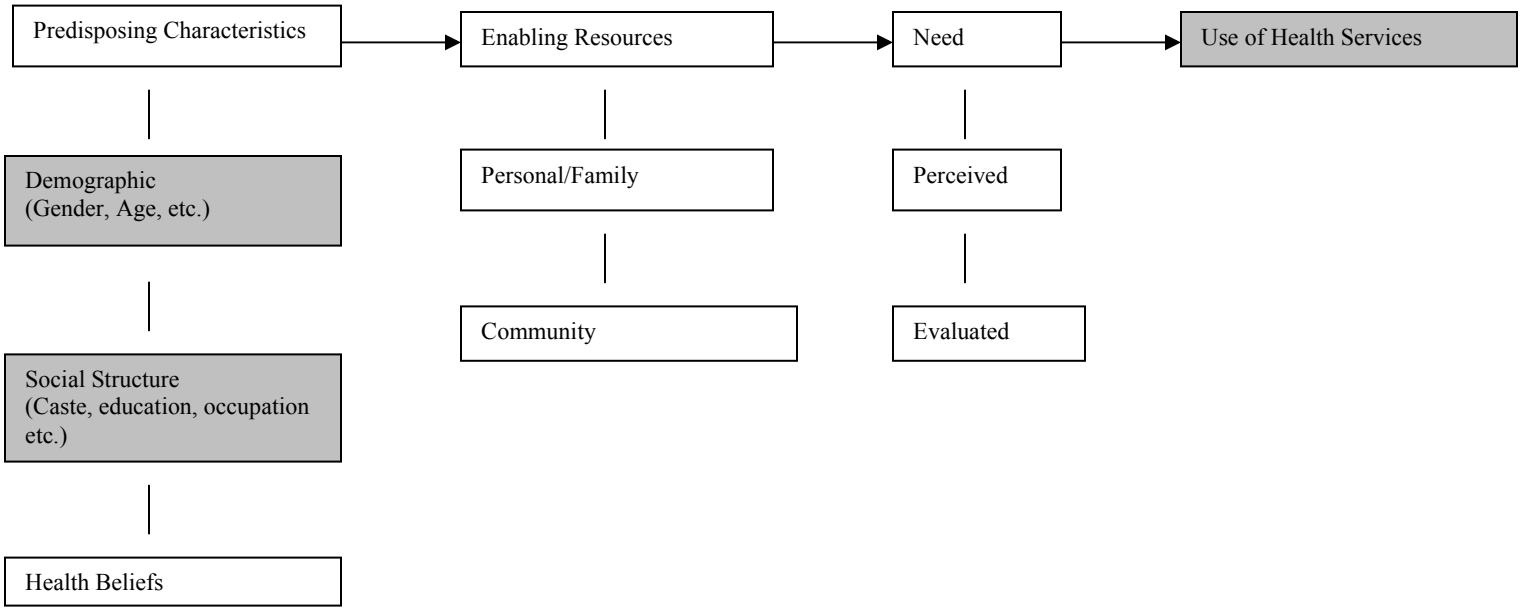

Figure 4. The Behavioral Model (1960's) by Aday and Andersen[117]

The shaded boxes indicate the predisposing characteristics that were studied to explain the healthcare utilization in this study.

healthcare seeking behavior of individuals and especially of the females in the family is determined by the characteristics of the family they belong to. In this socio-cultural context the initial model developed by Aday and Andersen in 1960[117] appropriately explains the health utilization behavior of women in rural India today.

Key constructs of the Aday and Andersen model include: a) predisposing characteristics such as demographic factors, social structure, and health beliefs of the individual, b) enabling resources such as resources within the family or the community, and c) perceived and evaluated healthcare need (Figure 4).[117, 118] Each component in the model has the potential to independently predict healthcare utilization.[117] At the same time the model also explained the causal ordering of the independent components.[117] Aday and Andersen suggested that people's use of health services is a function of their personal predisposition.[64, 112, 117, 119]

Predisposing factors are exogenous and can not be modified by an individual. Biological imperatives e.g., age or gender are such predisposing factors which determine the likelihood that people will need healthcare services.[117] These factors also reflect the fact that families with different characteristics have a different propensity to use healthcare services.[120] Moreover, these factors have very low mutability meaning that these factors cannot be modified to improve utilization of healthcare services.[117] Caste status of an individual is a predisposing factor which has no mutability. Caste status can be determinant of healthcare services utilization. The presence of predisposing factors may not be enough to influence any one's decision to seek healthcare.[112, 120] Other factors that enable or impede use of health services include personal and community factors such as financial status, transportation, distance from health facility, etc., as well as individual's per-

ceived need for care.[64, 112, 117, 119, 120] This model focused on utilization of healthcare from the physicians and at the hospitals.[117]

The components of this model have been revisited and improved to address other factors that determine utilization of sophisticated healthcare services in developed countries.[117] The original model (1960's) by Aday and Andersen's[117] has been used by researchers in India[43, 64, 106] to explain healthcare services utilization. This model provides an organizational structure for the determinants of pregnancy care,[119] therefore this model is appropriate for determining the factors that impact utilization of maternal and child healthcare services in rural areas of countries such as India.[43]

The demographic factors and social structure (shaded cells in Figure 4) – explanatory constructs – in the Aday and Andersen's[117] model were adapted for this study. In this study the demographic factors were maternal age, number of livings sons/brothers, neonate's gender, and maternal parity, and the social structure referred to caste, SES, and maternal literacy (Figure 4). In the given socio-cultural context these predisposing characteristics are known determinants of maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization. In this study the Aday and Andersen's[117] model was not tested rather the association between the elements of an explanatory construct (demographic characteristics and social structure) and utilization of maternal and neonatal healthcare services were explored.

Figure 5, the conceptual model, demonstrates the hypothesized association between the independent, dependent, and adjustment variables. The arrows in the conceptual model indicate the hypothesized associations and not causal pathways. It was conceptualized that maternal healthcare services utilization and neonatal care as well as neo-

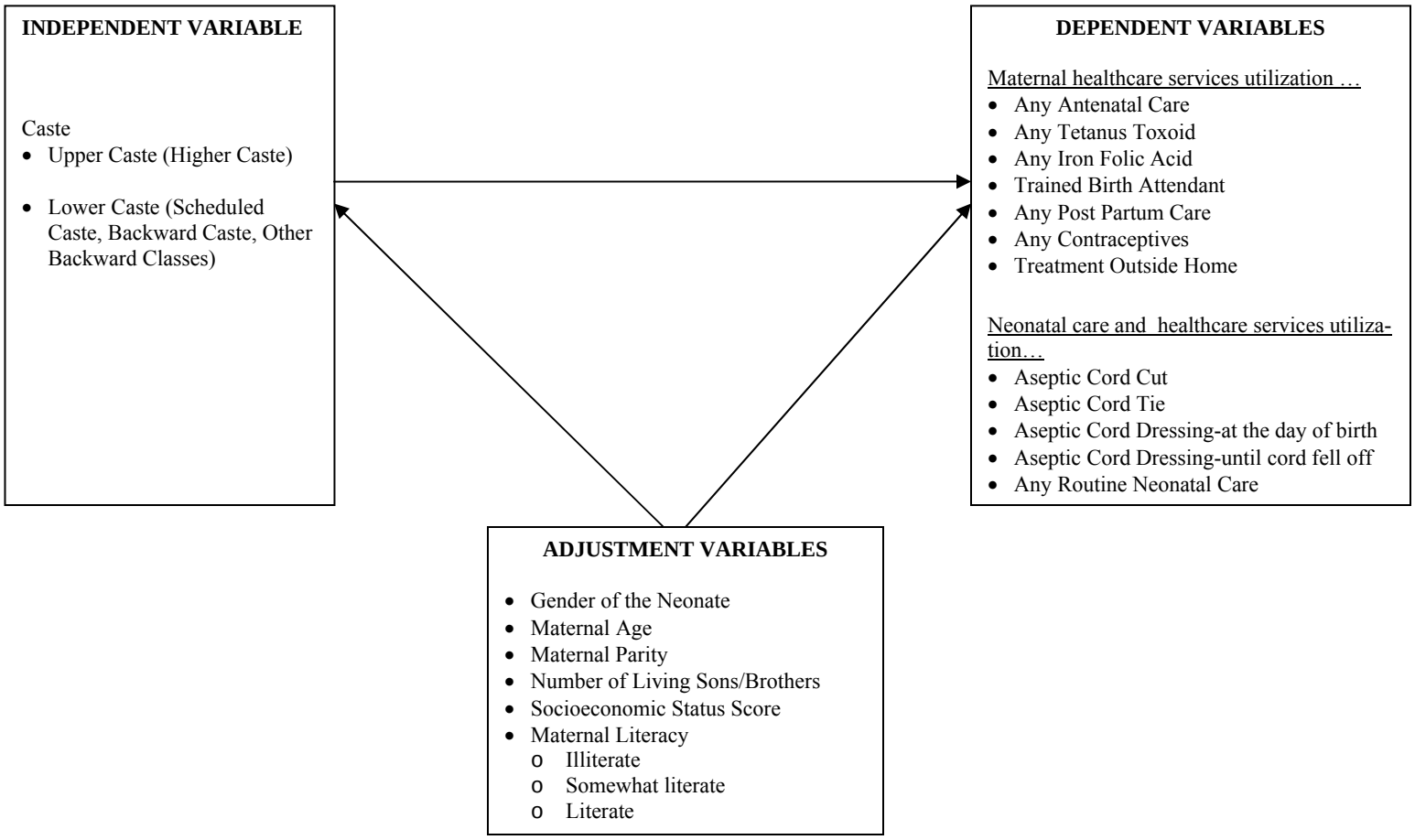

Figure 5. Conceptual Model Depicting Hypothesized Association between Independent, Dependent, and Adjustment Variable

natal healthcare services utilization are dependent on the caste status of the women and the neonates. On the left hand side of the model we had the independent variable, 'caste', which was categorical (higher caste, SC, OBC, and BC) and dichotomous (upper and lower caste). On the right hand side we had two sets of dependent variables to measure maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization by women and neonates. At the bottom of we had a set of adjustment variables or the socio-demographic factors that are potentially associated with both the independent and dependent variables.

Research Aims, Questions, and Hypotheses

The goal of the study was to explore if caste is a determinant of utilization of maternal and neonatal healthcare services. The primary objective of the study was to explore if caste is a determinant of maternal healthcare services utilization among Hindu women and if caste is a determinant of neonatal care as well as neonatal healthcare services utilization among live born singleton Hindu neonates in UP, India. The secondary objective was to determine if caste is a determinant of maternal healthcare services utilization among Hindu women and if caste is a determinant of neonatal care as well as neonatal healthcare services utilization among live born singleton Hindu neonates in UP, India after adjusting for the gender of the neonate, maternal age, maternal parity, number of livings sons/brothers, SES, and maternal literacy.

Specific Aim 1: To assess an association between caste and utilization of maternal healthcare services by Hindu women.

Research Question 1A: Do upper caste Hindu women have higher utilization of maternal healthcare services, as measured by the utilization of ANC, TT, IFA, presence of trained birth attendant, PPC, contraceptives, and treatment outside home, compared to lower caste Hindu women?

This research question was answered by testing the following seven research hypotheses.

H_{01}: There is no difference between upper caste and lower caste Hindu women with respect to the utilization of ANC.

H_{a1}: Upper caste Hindu women are more likely to utilize ANC compared to lower caste Hindu women.

H_{02}: There is no difference between upper caste and lower caste Hindu women with respect to the receipt of TT shots.

H_{a2}: Upper caste Hindu women are more likely to receive TT shots compared to lower caste Hindu women.

H_{03}: There is no difference between upper caste and lower caste Hindu women with respect to the ingestion of IFA.

H_{a3}: Upper caste Hindu women are more likely to ingest IFA compared to lower caste Hindu women.

H_{04}: There is no difference between upper caste and lower caste Hindu women with respect to the presence of trained birth attendant.

H_{a4}: Upper caste Hindu women are more likely to have a trained birth attendant compared to lower caste Hindu women.

H_{05}: There is no difference between upper caste and lower caste Hindu women with respect to the utilization of PPC.

H_{a5}: Upper caste Hindu women are more likely to utilize PPC compared to lower caste Hindu women.

H_{06}: There is no difference between upper caste and lower caste Hindu women with respect to the use of contraceptives.

H_{a6}: Upper caste Hindu women are more likely to use contraceptives compared to lower caste Hindu women.

H_{07}: There is no difference between upper caste and lower caste Hindu women with respect to utilization of treatment outside home.

H_{a7}: Upper caste Hindu women are more likely to utilize treatment outside home compared to lower caste Hindu women.

If one or more null hypotheses stated above were rejected then we proceeded to research question 1B.

Research Question 1B: Is caste associated with the utilization of maternal health-care services, as measured by the utilization of ANC, TT, IFA, presence of trained birth attendant, PPC, contraceptives, and treatment outside home, after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy?

This research question was answered by testing the following seven research hypotheses.

H_{08}: There is no difference between the upper caste and lower caste Hindu women with respect to the utilization of ANC after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a8}: Upper caste Hindu women are more likely to utilize ANC compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{09}: There is no difference between the upper caste and lower caste Hindu women with respect to receipt of TT shots after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a9}: Upper caste Hindu women are more likely to receive TT shots compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{010}: There is no difference between the upper caste and lower caste Hindu women with respect to ingestion of IFA after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a10}: Upper caste Hindu women are more likely to ingest IFA compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{011}: There is no difference between the upper caste and lower caste Hindu women with respect to the presence of trained birth attendant after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a11}: Upper caste Hindu women are more likely to have a trained birth attendant compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{012}: There is no difference between the upper caste and lower caste Hindu women with respect to the utilization of PPC after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a12}: Upper caste Hindu women are more likely to utilize PPC compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{013}: There is no difference between the upper caste and lower caste Hindu women with respect to the utilization of contraceptives after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a13}: Upper caste Hindu women are more likely to use contraceptives compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{014}: There is no difference between the upper caste and lower caste Hindu women with respect to the utilization of treatment outside home, after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

H_{a14}: Upper caste Hindu women are more likely to utilize treatment outside home compared to lower caste Hindu women after adjusting for maternal age, maternal parity, number of livings sons, SES, and maternal literacy.

Specific Aim2: To assess association between caste and neonatal care and utilization of neonatal healthcare services by live born singleton Hindu neonates.

Research Question 2A: Do upper caste singleton Hindu neonates receive aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth), aseptic cord dressing (until cord fell off), routine NNC, and treatment outside home, compared to lower caste singleton Hindu neonates?

This research question was answered by testing the following six research hypotheses.

H_{016}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receiving aseptic cord cut.

H_{a16}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord cut compared to the lower caste Hindu neonates.

H_{017}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receiving aseptic cord tie.

H_{a17}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord tie compared to the lower caste Hindu neonates.

H_{018}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receiving aseptic cord dressing (at the day of birth).

H_{a18}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord dressing (at the day of birth) compared to lower caste Hindu neonates.

H_{019}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receiving aseptic cord dressing (until cord fell off).

H_{a19}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord dressing (until cord fell off) compared to lower caste Hindu neonates.

H_{020}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to the utilization of routine NNC.

H_{a20}: Upper caste singleton Hindu neonates are more likely to utilize routine NNC compared to the lower caste Hindu neonates.

H_{021}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to the utilization of treatment outside home.

H_{a21}: Upper caste singleton Hindu neonates are more likely to utilize treatment outside home compared to lower caste Hindu neonates.

If one or more null hypotheses stated above were rejected we then proceeded to research question 2B.

Research Question 2B: Is caste associated with the receipt of aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth), aseptic cord dressing (until cord fell off), routine NNC, and treatment outside home, after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy?

This research question was answered by testing the following six research hypotheses.

H_{022}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receipt of aseptic cord cut after adjusting for the gender of

the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{a22}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord cut compared to the lower caste singleton Hindu neonates, after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{023}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receipt of aseptic cord tie after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{a23}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord tie compared to the lower caste singleton Hindu neonates, after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{024}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receipt of aseptic cord dressing (at the day of birth) after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{a24}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord dressing (at the day of birth) compared to the lower caste singleton Hindu neonates, after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{025}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to receipt of aseptic cord dressing (until cord fell off) after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{a25}: Upper caste singleton Hindu neonates are more likely to receive aseptic cord dressing (until cord fell off) compared to the lower caste singleton Hindu neonates, after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{026}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to utilization of routine NNC after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{a26}: Upper caste singleton Hindu neonates are more likely to utilize routine NNC compared to the lower caste singleton Hindu neonates, after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{027}: There is no difference between the upper caste and lower caste singleton Hindu neonates with respect to utilization of treatment outside home after adjusting for the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

H_{a27}: Upper caste singleton Hindu neonates are more likely to utilize treatment outside home compared to the lower caste singleton Hindu neonates, after adjusting for

the gender of the neonate, maternal age, maternal parity, number of living brothers, SES, and maternal literacy.

RESEARCH METHODS

The Morbidity and Performance Assessment (MAP) Study

MAP was a baseline study completed during 1998-2000 as part of the Community Partnerships for Safe Motherhood Project by the American College of Nurse Midwives, Program for International Training in Health, and local non-governmental agency, *Shramik Bharti*[121] in Maitha block, Kanpur *Dehat,* UP, India.[122]

Every state in India comprises of districts, sub-districts/blocks, and villages. Kanpur in UP, is an administrative sub-division with two sub-units: Kanpur *Nagar* (city) which is a major industrial city, and the adjacent Kanpur *Dehat* (rural) which is a less developed rural region. Kanpur *Dehat* has a population of 1.6 million.[94] Within Kanpur *Dehat* there are several districts, one of which is Akbarpur. Akbarpur is further subdivided into several blocks. Maitha, the study site, is one of those blocks (Figure 1). Maitha has a population of approx. 134,000 spread among about 65 villages and hamlets.[123]

MAP was a population-based retrospective cross-sectional study.[122] The purpose of the MAP study was to collect data on the causes and contextual determinants of maternal and neonatal morbidity and mortality.[20] It was designed to identify women and neonates who experienced major Life Threatening Complications (LTC) and their response to such LTC.[20] MAP study design was based on the WHO verbal autopsy

method,[124] adapted for use with women who survived a LTC, as well as those who died.[20, 122]

The study sample was identified from 11 villages and 29 hamlets from Maitha block[20, 123] at the convenience of the local non-governmental agency, *Shramik Bharti*. The selected study area had a population of 22,779[20] persons representing approximately 20% of the total Maitha block population.[20, 123] An eligible case was defined as any woman (15-49 years old) who experienced an abortion or who had a planned home delivery during 1998 and her neonate, whether she or the neonate survived.[20] Sample size was calculated for a target effect size of 0.40, a one-tailed test where ($\alpha = 0.05$ and statistical power = 0 .80),[125] assuming a crude birth rate of 4% and a conservative estimate of maternal morbidity rate of 10%.[20] At least 80 eligible cases reporting symptoms of a LTC were required to assess change in recognition and response to LTC.[20] Seven hundred twenty-eight women in the study population were pregnant during the study period, of them 713 had planned a home birth and were eligible to participate in the study.[20] Six hundred eighty-eight women resided in the study area; these women were contacted for interviews during July-December 1999.[20] Complete interviews for 627 women (88% of all eligible cases) were available.[20, 122]

Data were collected using an in-depth interview questionnaire which was developed in English and administered to the eligible women in the local dialect of the Hindi language after translation.[20] Bi-directional (English-Hindi-English) translation was applied to facilitate data collection, extraction, and analyses. Prior to implementation of the MAP study, all partner agencies independently reviewed and approved the study protocols for methodological soundness and protection of human subjects.[20] Informed consent

was obtained verbally and women and families were free to participate or withdraw from the study at any time.[20] The questionnaire was interviewer-administered.[20] Responses were documented in the questionnaire and audiotape recorded in the local language.[20] These methods were appropriate since majority of the study subjects were unable to read and write.[20] Except for the cases of maternal death, the woman was the primary respondent.[20] Family members and health providers were also allowed to participate in the interview with the permission of the woman being interviewed.[20]

Data quality measures included re-visits to 2% of the households to verify case eligibility, multiple/additional questions to improve consistency of responses, field and office review of each questionnaire against a checklist and audiotape recorded responses for internal consistency, skip patterns, and missing data.[20] Extreme values were verified against a checklist, in addition to the use of double data entry and continuous data cleaning for errors that emerged during preliminary analyses.[20]

Research Methods for the Proposed Study

Study Design

The study objectives and research questions were answered through secondary analyses of the MAP study data.[122] The study design was population-based retrospective cross-sectional survey.

Study Sample

From the MAP study sample a sub-sample for this study was selected using the following inclusion-exclusion criteria.

Caste discrimination is predominant in the Hindu religion; therefore, only Hindu women were selected. All Hindu women who gave birth to a live born singleton neonate either at home or at a health facility following a full-term pregnancy that occurred during Jan 1998-Jan 1999 and who survived from conception to 42 days postpartum were included in this study. Only live born singleton Hindu neonates who were born either at home or at a health facility following the pregnancy that occurred during Jan 1998-Jan 1999 and who survived until 28 days after birth were included.

From the available sample of 627 study subjects,[121] 145 did not match the inclusion-exclusion criteria. Those excluded: belonged to Muslim or other religion (N=35), had an abortion i.e., <6 months gestation (N=57); had a still-born neonate (N=16); had multiple gestation (N=11); died during pregnancy, labor, or during 42 days postpartum (N=8); the neonate died during 1-28 days after birth (N=18); or the available interview was incomplete (N=4). A few study subjects (N=4) had multiple characteristics such as multiple gestation, still birth, and incomplete interview therefore these study subjects were excluded for multiple reasons.

Four hundred eighty-two (482) women and their 464 live born singleton neonates fulfilled the eligibility criteria.

Power Analysis

Power analysis was done using the PS: Power and sample size calculation software[126] to test the power (or ability) of the expected results to reject the null hypotheses if the null was actually false and minimize the likelihood of committing Type II error. We did power analysis to assess the ability of our study results to identify a difference in the utilization of ANC by upper caste and lower caste women, if such a difference truly exists.

For power analysis we made the following assumptions: we set α at the conventional level of 0.05 to minimize Type I error; from the MAP preliminary report we know the lower-upper caste ratio (4:1) and that 100 women belong to the upper caste;[121] we estimated that 25% lower caste women utilize ANC based on the data from a recent study from northern India, including the state of UP (rural residents with characteristics similar to women in Maitha).[11] These assumptions were used to do power analysis with the fixed sample of 500 and for the anticipated odds ratios ranging from 1.25 to 2.50 (Table 5).

Table 5. Power Analysis for the Proposed Study

Alpha: Type I error probability for a two-sided test	α	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Number of cases or upper caste women	N	100	100	100	100	100	100	100
Probability of exposure (i.e., the likelihood of utilizing ANC) among controls (i.e., the lower caste women)	P_0	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Ratio of lower and upper caste women	M	4:1	4:1	4:1	4:1	4:1	4:1	4:1
Hypothesized odds ratio of exposure (utilization of ANC) among cases (upper caste women) relative to controls (lower caste women)	ψ	1.25	1.50	1.75	1.85	1.90	**2.00**	2.50
Power	$1-\beta$	0.12	0.35	0.61	0.69	0.73	**0.80**	0.96

We found that if the odds ratio was 2.00 then we had 80% power to reject the null hypothesis if it was actually false also the likelihood of committing Type II error was at the acceptable level of 20%. However, when the odds ratio was 1.25, then we had only 12% power to reject the false null and the Type II error was unacceptably high, 88%. The Type II error will be too high when the observed association is weak or moderate (OR<2.00). Power analysis indicated that under the above described assumptions in order to reject the false null the study results should have OR ≥ 2.00 to achieve 80% power and to minimize the likelihood of committing Type II error at the acceptable level of 20%.

Post-hoc Power Analysis

Post-hoc power analysis was done once the results from data analysis were available. PS: Power and sample size calculation software[126] was used. Power of the study results (crude and adjusted odds ratio for the utilization of each maternal and neonatal services) were calculated by setting: Type I error or α at 0.05; the lower-upper caste ratio among women was 5:1 and 75 women belonged to the upper caste; the lower-upper caste ratio among neonates was 6:1 and 71 neonates belonged to the upper caste; the probability of utilizing specific healthcare services by lower caste group relative to the upper caste group was also known (Table 6, 7). If the study results did not attain the power of 0.80 then a sample size (required number of cases or upper caste women) that can give a power of 0.80 was calculated for each outcome of interest.

Table 6. Post-hoc Power Analysis for Maternal Healthcare Services Utilization

	Probability of exposure (utilization) in controls (lower caste women) (P_0)	**Crude OR (ψ)**	**Power ($1-\beta$)**	**Required sample size (case s/UC women)**	**Adjusted OR (ψ)**	**Power ($1-\beta$)**	**Required sample size (case s/UC women)**
Antenatal Care	0.08	2.72	0.73	88	2.39	0.59	122
Tetanus Toxoid	0.46	2.50	**0.93**	N/A	2.19	**0.83**	N/A
Iron Folic Acid	0.14	1.70	0.34	236	1.13	0.03	5020
Trained Birth Attendant	0.02	4.77	0.70	98	3.49	0.47	174
Contraceptives	0.07	2.66	0.66	104	1.98	0.35	237
Treatment outside home	0.07	0.79	0.06	3043	0.85	0.06	6093

α =0.05, n=75, Ratio of lower and upper caste women (m)=5:1.

Table 7. Post-hoc Power Analysis for Neonatal Care and Healthcare Services Utilization

	Probability of exposure (utilization) in controls (lower caste neonates) (P_0)	**Crude OR (ψ)**	**Power ($1-\beta$)**	**Required sample size (case s/UC neonates)**
Aseptic cord cut	0.75	0.85	0.06	1792
Aseptic cord tie	0.07	1.54	0.14	631
Aseptic cord dressing-at the day of birth	0.12	0.82	0.05	2485
Aseptic cord dressing-until cord fell off	0.04	1.10	0.03	25065
Routine care	0.02	0.68	0.03	4165
Treatment outside home	0.02	2.84	0.32	261

α =0.05, n=71, Ratio of lower and upper caste neonates (m)=6:1.

We found that except for one study result none of the study results had enough power ($\geq$ 80%) to identify caste difference in either maternal or neonatal healthcare services utilization, if such a difference truly exists (Table 6, 7). Upper caste women were

twice as likely to receive TT shots compared to the lower caste women; the study results had more than 80% power, we can safely conclude that caste differences exist because the likelihood of committing Type II error was as low as 7% (Table 6). The utilization of ANC was higher among the upper caste women compared to the lower caste women but the study results had low power. The likelihood of committing an error of concluding that caste differences exists was 27% therefore we need to examine this results with caution. Similarly, the utilization of trained birth attendant and contraceptives was also higher among the upper caste women compared to the lower caste women, but due to low power of study results the likelihood of committing Type II error was higher than 20%. Caste differences with respect to ANC utilization, trained birth attendant, and contraceptive utilization need to be interpreted with caution to avoid erroneous conclusions.

Among the neonates we had failed to reject the hypothesized association between caste and neonatal care as well as neonatal healthcare services utilization, therefore the adjusted models were not built (Table 7). The study results for the crude model for all the outcomes of interest had very low power. Since the likelihood of committing Type II error was unacceptably high, these results also need to be interpreted with caution.

Data Structure

The MAP questionnaire (data dictionary inclusive) was readily available in English as well as in Hindi language. Forms 1 and 2A-D of MAP questionnaire were relevant to the proposed study. Data for each section/form were available in SPSS 13.0[127] in five related data files. Documented and audiotaped interviews protected by unique identifiers (case identification numbers) were also available. A summary of the MAP findings was available from the preliminary data analysis report.[121]

For this study, complete MAP data for 482 women and 464 neonates were extracted and utilized. Selection of eligible cases and variables of interest from the five data files is described in detail in the 'Data Analysis' section.

Study Variables

To answer the research questions and to test the proposed hypotheses, some variables were used as available (not modified) while others were recoded, computed, or derived. Table 8 lists all the variables that were extracted from the MAP questionnaire. A description of the study variables follows.

Independent Variable

Caste- Respondents in this study were asked about the traditional family occupation or the caste to which they belonged. Women belonged to SC, BC, higher caste, or OBC caste group. The four unmodified caste categories were utilized as one variable and they were modified to create another dichotomous variable with two categories: "lower caste=0", representing SC, backward caste, and OBC, women, and "upper caste=1", representing only the higher caste women.

Caste is a function of the traditional family occupation in this community. Women were also asked about the occupation of the head of the household. Those belonging to 'other' caste groups and those with missing caste information were assigned to "upper" or "lower" caste categories after reviewing the occupation of the head of the household. Any discrepancy in caste categorization was resolved by cross tabulation of these responses against the occupation of the head of the household. Responses to caste

Table 8. Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
INDEPENDENT VARIABLE			
Caste	What is your traditional family occupation? OR To which caste does your family belong? 01. Schedule Caste 02. Backward Caste 03. Higher Caste 04. Other Backward Classes 05. Schedule Tribe 96. Other (specify) 99. Not Applicable	* 05, 99- Deleted * 96- Information on occupation of the head of the household used to define responses	Categori-cal/Nominal
Caste (Derived)	What is your traditional family occupation? OR To which caste does your family belong? 01. Schedule Caste 02. Backward Caste 03. Higher Caste 04. Other Backward Classes 05. Schedule Tribe 96. Other (specify) 99. Not Applicable	0. Lower Caste = 01, 02, 04 1. Upper Caste = 03 * 05, 99- Deleted * 96- Information on occupation of the head of the household used to define responses	Dichotomous
MATERNAL HEALTHCARE SERVICES			
Routine ANC	**Qa.** During this pregnancy, did you go for a routine checkup to be sure that you and the unborn baby were healthy? 01. Yes, months 1-3 02. Yes, months 4-6 03. Yes, months 7-9 04. No, did not go for checkup 99. Not Applicable	0. No = 04, 99 1. Yes = 01, 02,03	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
MATERNAL HEALTHCARE SERVICES (Continued)			
ANC Provider	**Qb.** To whom did you go? 01. Mentioned 02. Not Mentioned 99. Not Applicable …… a. Dhankun b. Dai c. Bhagat/ Ojha d. Village Doctor e. Nurse f. English Doctor g. Pharmacist h. Other (specify)	0. Untrained provider = 'a', 'b', 'd', 'g', 99 1. Trained provider = 'e', 'f' * 'h' – Information on provider's location used to define responses. * If multiple responses indicated presence of trained providers, they were coded as '1'.	Dichotomous
Any ANC (Derived)	ANC by a trained provider	0. No ANC = If Qa & b = 0 1. Yes ANC = If Qa & b= 1	Dichotomous
Any IFA	Did you take iron tablets for 'less blood' or anemia? ### 999. Not Applicable	0. No IFA= 0 or >400 1. Yes IFA= 1 to 400	Dichotomous
TT	**Qa.** Did you receive an injection during pregnancy to keep you or baby from getting tetanus (fits)? ## 99. Not Applicable	0. No TT = 0 or >4 1. Yes TT = 01 to 04	Dichotomous
TT	**Qb.** Did you receive a similar injection in your previous pregnancies? ## 99. Not Applicable	0. No TT = 0 or >4 1. Yes TT = 01 to 04	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
MATERNAL HEALTHCARE SERVICES (Continued)			
Any TT (Derived)	Any TT utilization.	0. No TT = If Qa & b = 0 1. Yes TT = If Qa or b = 1	Dichotomous
Routine PPC	**Qa.** Did you go outside the home for a routine checkup to be sure everything was normal during the first six weeks after the--- (delivery, miscarriage or abortion)? 01. Yes, Week 1 02. Yes, Week 2 03. Yes, Week 3 04. Yes, Week 4-6 05. Yes, after 6 weeks (specify) 06. No, did not go for checkup 96. Other (specify)	0. No PPC = 06 1. Yes PPC = 01, 02,03, 04, 05 * 96 – If time period not known then '0'. * If PPC after 42 days then '0'.	Dichotomous
PPC Provider	**Qb.** To whom did you go? 01. Mentioned 02. Not Mentioned 99. Not Applicable …… a. Dhankun b. Dai c. Bhagat/ Ojha d. Village Doctor e. Nurse f. English Doctor g. Pharmacist h. Other (specify)	0. Untrained provider = 'a', 'b', 'd', 'g', 99 1. Trained provider = 'e', 'f' * 'h' –Information on provider's type used to define responses. * If multiple responses indicate presence of trained provider, they were coded as '1'.	Dichotomous
Any PPC (Derived)	PPC by a trained provider	0. No PPC = If Qa & b =0 1. Yes PPC = If Qa & b =1	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
MATERNAL HEALTHCARE SERVICES (Continued)			
Any Contraceptive Use	Are you or your husband/partner using a method of family planning now? 01. Yes 02. No 99. Not Applicable	0. No Contraceptive = 02, 99 1. Yes Contraceptive = 01	Dichotomous
Treatment outside home – Antepartum	**Qa.** Did you seek any care or treatment for this problem outside of the home? 01. Yes 02. No 99. Not Applicable	0. No Treatment outside home = 02, 99 1. Yes Treatment outside home = 01	Dichotomous
Treatment outside home – Intrapartum	**Qb.** Did you seek any care or treatment for this problem outside of the home? 01. Yes 02. No 99. Not Applicable	0. No Treatment outside home = 02, 99 1. Yes Treatment outside home = 01	Dichotomous
Treatment outside home – Postpartum	**Qc.** Did you seek any care or treatment for this problem outside of the home? 01. Yes 02. No 99. Not Applicable	0. No Treatment outside home = 02, 99 1. Yes Treatment outside home = 01	Dichotomous
Seeking treatment outside home (Derived)	Treatment outside home sought by women during any time period	0. None = if Qa, Qb, and Qc = 0 1. One or more = if Qa or Qb or Qc=1	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
MATERNAL HEALTHCARE SERVICES (Continued)			
Trained birth attendant	During labor, birth and in the first 24 hrs after birth, who mainly provided care to you and the baby? For example, who….? 01. Women herself 02. Husband 03. Mother-in-law 04. Mother 05. Sister-in-law (Jethani) 06. Sister-in-law (Devrani) 07. Sister-in-law (Nanand) 08. Sister-in-law (Bhabhi) 09. Other relative (specify) 10. Friend/Neighbor 11. Dhankun 12. Dai 13. Bhagat / Ojha 14. Village Doctor 15. Nurse 16. English Doctor 17. No one 96. Other 97. Don't know …… a. Provided physical & emotional support before birth b. Caught the baby as it came out c. Cleaned baby's body after birth d. Caught the placenta e. Tied the baby's cord f. Cut the baby's cord g. Disposed of the placenta h. Cleaned your body after birth	Response options for only 'c (caught the baby as it came out)' were considered. 0. Untrained birth attendant = 01 to 14 and 17. 1. Trained birth attendant = 15 to 16. * '96'- Information on title of the provider used to define the responses. * If multiple responses indicate presence of either, '15' or '16' they were coded as '1'. * '97'- Missing data.	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
NEONATAL CARE AND HEALTHCARE SERVICES			
Cord cut	**Qa.** What instrument was used to cut the baby's umbilical cord? 01. Broken glass or bangle 02. Knife 03. New razor blade 04. Old razor blade 05. Scissors 06. Sickle 96. Other (specify) 99. Not Applicable	0. Septic instrument = 01, 02, 04, 05, 06, 96, or 99 1. Aseptic instrument = 03	Dichotomous
Instrument preparation (cord cut)	**Qb.** How was this instrument prepared? 01. Washed in spirits or antiseptic 02. Washed in water only 03. Boiled in water 04. Boiled in water and antiseptic 05. Baked in oven or burnt in fire 06. Wiped with cloth only 07. Nothing special was done 96. Other (specify) 97. Don't know 99. Not Applicable	0. Septic preparation = 05, 06, 07, 96, 97, or 99 1. Aseptic preparation = 01, 02, 03, or 04	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
NEONATAL CARE AND HEALTHCARE SERVICES (Continued)			
Timely preparation (cord cut)	**Qc.** When was this instrument prepared? 01. More than 1 week before birth 02. Within a week of birth 03. On the day of delivery 04. After delivery 96. Other (specify) 97. Don't know 99. Not Applicable	0. Untimely preparation = 01, 02, 96, 97, or 99 1. Timely preparation = 03 or 04	Dichotomous
Aseptic cord cut (Derived)	Aseptic instrument for cutting the cord.	0. No = If Qa, b, & c= 0 1. Yes = If Qa, b, c=1	Dichotomous
Cord tie	**Qa.** What material was used to tie the cord? 01. Thread 96. Other (specify) 99. Not Applicable	0. Septic material = 96, 99 1. Aseptic material = 01	Dichotomous
Material preparation (cord tie)	**Qb.** How was the cord tie prepared before it was used? 01. Washed in alcohol or antiseptic 02. Washed in water only 03. Boiled in water 04. Boiled in water and antiseptic 05. Baked in oven 06. Wiped with cloth only 07. Nothing special was done 96. Other (specify) 97. Don't know 99. Not Applicable	0. Septic preparation = 05, 06, 07, 96, 97, or 99 1. Aseptic preparation = 01, 02, 03, or 04	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
NEONATAL CARE AND HEALTHCARE SERVICES (Continued)			
Timely preparation (cord tie)	**Qc.** When was the cord tie prepared before it was used? 01. More than 1 week before birth 02. Within a week of birth 03. On the day of delivery 04. After delivery 96. Other (specify) 97. Don't know 99. Not Applicable	0. Untimely preparation = 01, 02, 96, 97, or 99 1. Timely preparation = 03 or 04	Dichotomous
Aseptic cord tie (Derived)	Aseptic material for tying the cord.	0. No = If Qa, b, & c= 0 1. Yes = If Qa, b, c=1	Dichotomous
Aseptic cord dressing-until cord fell off (Derived)	**Qa.** What, if anything, was put on the baby's umbilical cord until it fell off? 01. Mentioned 02. Not mentioned 99. Not applicable …….. a. Mustard oil b. Gentian violet (blue medicine) c. Vermilion d. Ash e. Cow dung f. Sulfa powder g. Antibiotic medicine h. Cotton wool covering i. Belly binder j. Other (specify)	0. Septic dressing = a, c, d, e, j, or 99 1. Aseptic dressing = b, f, g, h, or 'i'	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
NEONATAL CARE AND HEALTHCARE SERVICES (Continued)			
Aseptic cord dressing-at the day of birth (Derived)	**Qa.** What substance was placed on the baby's umbilical cord to dress it for the first time? 01. Mentioned 02. Not mentioned 99. Not applicable …….. a. Mustard oil b. Gentian violet (blue medicine) c. Vermilion d. Ash e. Cow dung f. Antibiotic medicine g. Nothing h. Other (specify)	0. Septic dressing = a, b, c, d, e, h, or 99 1. Aseptic dressing = b, f, or 'g'	Dichotomous
Any Routine NNC	When did you first take the baby for a routine checkup to be sure everything was normal, if at all? 01. Week 1 02. Week 2 03. Week 3 04. Week 4 05. 4-6 weeks 06. After sixth week 07. Did not take baby 96. Other, specify	0. No routine NNC = 05,06,07 1. Yes routine NNC = 01,02,03,04 *96 – If provider not known then '0'. * If routine NNC after week 4 then '0'.	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
NEONATAL CARE AND HEALTHCARE SERVICES (Continued)			
Treatment outside home – Newborn (2-28 days)	**Qa.** Did you seek any care or treatment for this problem outside of the home? 01. Yes 02. No 99. Not Applicable	0. No Treatment outside home = 02, 99 1. Yes Treatment outside home = 01	Dichotomous
Treatment outside home – Newborn (0-1 day)	**Qb.** Did you seek any care or treatment for this problem outside of the home? 01. Yes 02. No 99. Not Applicable	0. No Treatment outside home = 02, 99 1. Yes Treatment outside home = 01	Dichotomous
Seeking treatment outside home (Derived)	Treatment outside home sought for the neonate during any time period	0. None = if Qa or Qb = 0 1. One or more = if Qa or Qb = 1	Dichotomous
ADJUSTMENT VARIABLES			
Gender of the neonate	**Qa.** Was this a girl or boy baby? 01. Girl 02. Boy 03. Girl-Girl 04. Girl-Boy 05. Boy-Girl 06. Boy-Boy	0 = Female = 01 1 = Male = 02 *Cases deleted if '03'-'06'	Dichotomous

Table 8. (Continued) Description of Independent, Dependent, and Adjustment Variables

Variable Name	Questions	Value Description & Computation of Variables	Variable Type
ADJUSTMENT VARIABLES (Continued)			
Sex composition of living children	**Qb.** Among these children, how many are daughters? How many are sons? ## ##		Discrete
Number of living sons/brothers (Derived)	Total number of living sons.	Qb-1 if Qa=02 (male)	Continuous
Maternal age	How old were you at your last birthday? OR What do you think your age is? ##	##	Continuous
Maternal parity	This means that the total number of times you have ever given a birth is… ##	##	Continuous
SES Score	SES score for the woman/family.	SES score range 2-42	Continuous
Maternal literacy	Can you read and understand a letter (or newspaper) easily, with difficulty, or not at all? 01. Easily 02. With difficulty 03. Not at all 99. Not Applicable (Educated up to 10th grade and above)	0. Illiterate = 03 1. Somewhat Literate = 02 2. Literate = 01, 99	Categorical

affiliation were considered the "gold standard". The assigned caste categories are appropriate for the study area and are consistent with those used by the Census of India and other researchers in the country.

Dependent Variables

Utilization of maternal healthcare services was assessed through various indicators including utilization of any ANC, any IFA, any TT, presence of trained birth attendant, any PPC, treatment outside home for LTC experienced during antepartum, and/or during labor and birth, and/or postpartum periods, and contraceptive use.

Any ANC- Antenatal care is synonymous to prenatal care, starting from conception (trimester 1) until delivery (trimester 3). Women were asked if they sought routine check-ups either during 1-3 months, 4-6 months, 7-9 months of pregnancy, or if they did not go for check-ups. The response options were sub-categorized into, "no=0", indicating no ANC, and "yes=1", indicating ANC during 1-3 months, and/or 4-6 months, and/or 7-9 months. A similar question indicating total number of ANC visits was used to check for consistency of responses and to correct data entry errors. Women were also asked about the type of provider they had sought ANC from. These ANC providers were subcategorized into two groups, "untrained providers=0", representing *Dhankun*, and/or *Dai*, and/or *Bhagat*/*Ojha* (healers), and/or Village Doctor (unqualified medical practitioners), and/or pharmacist and "trained providers=1", representing Nurse and/or English Doctor (qualified medical practitioners). ANC providers reported as 'Other' were assigned to the appropriate categories after assessing the site or the healthcare facility where they provide services and by assessing the traditional "title" (such as aunt, niece, spiritual healer, etc.)

of the provider. If a woman reported utilizing both trained and untrained ANC provider then the response option was coded as "1=trained providers".

Since the primary interest of this study was to determine the utilization of ANC from a trained provider, irrespective of the time period, the two variables mentioned above were used to compute a new variable, 'Any ANC', which indicated ANC sought from a trained provider. The response options were sub-categorized into, "no=0", indicating no ANC or ANC from traditional providers, and "yes=1", indicating ANC at any time during pregnancy from a trained provider.

Any IFA- Women were also asked the number of IFA tablets they had taken during the pregnancy. The discrete responses were categorized into two groups, "no=0" indicating no ingestion of IFA tablets, and "yes=1" indicating ingestion of one or more IFA tablets.

Any TT- Women were also asked how many TT shots they had received either during the 1998 pregnancy or during a previous pregnancy (if applicable). These responses were categorized into two groups, "no=0" indicating no TT shots during either pregnancy, and "yes=1" indicating receipt of 1-4 TT shots during either pregnancy.

Trained Birth Attendant- Women were asked about the person who had caught the baby when the baby was born. Women were assisted by one or more of the following: the woman herself (no one), husband, female family members, other relatives, friend/neighbor, *Dhankun*, *Dai*, *Bhagat*/*Ojha* (healers), Village Doctor (unqualified medical practitioners), Nurse, English Doctor (qualified medical practitioners), pharmacist, and 'other'. These response options were categorized into two groups, "no/untrained birth attendant=0", representing assistance from the woman herself (no one), and/or hus-

band, and/or female family members, and/or other relatives, friend/neighbor, and/or *Dhankun*, and/or *Dai*, and/or *Bhagat*/*Ojha* (healers), and/or Village Doctor (unqualified medical practitioners), and/or pharmacist and "trained birth attendant=1", representing assistance from, Nurse, and/or English Doctor (qualified medical practitioners). Delivery attendants reported as 'Other' were assigned to the appropriate categories after assessing the traditional "title" (such as aunt, niece, spiritual healer, etc.) of the attendant. If a woman reported utilizing both trained and untrained assistance then the response option was coded as "1=trained birth attendant".

Any PPC- Women were asked if they sought routine PPC either during week 1, week 2, week 3, weeks 4-6, after 6 weeks, during any other time period, or if they did not seek postpartum check-ups. The response options were sub-categorized into, "yes=1", indicating PPC during week 1, 2, 3, or 4-6. If the woman reported seeking PPC 42 days after delivery or abortion, the response options were categorized under "no=0". Women were also asked about the type of provider they had sought PPC from. These PPC providers were categorized into two groups, "untrained providers=0", representing *Dhankun*, and/or *Dai*, and/or *Bhagat*/*Ojha* (healers), and/or Village Doctor (unqualified medical practitioners), and/or pharmacist and "trained providers=1", representing Nurse and/or English Doctor (qualified medical practitioners). PPC providers reported as 'Other' were assigned to the appropriate categories after assessing the site or the healthcare facility where they provide services and after assessing the traditional "title" (such as aunt, niece, spiritual healer, etc.) of the provider. If a woman reported utilizing both trained and untrained PPC provider then the response option were coded as "1=trained providers".

Similar questions on health facility visited for PPC were used to check for consistency of responses and to correct data entry errors.

Since the primary interest of this study was to determine the utilization of PPC from a trained provider, irrespective of the time period, the above mentioned two variables were used to compute a new variable, 'Any PPC', that indicated PPC sought from a trained provider. The response options were sub-categorized into, "no=0", indicating no PPC or PPC from traditional providers, and "yes=1", indicating PPC during week 1, 2, 3, or 4-6 from a trained provider.

Any Contraceptive Use - Another indicator of utilization of maternal healthcare services is the utilization of contraceptives. Women were asked about the contraceptives they were using at the time of the interview. Those not using a contraceptive were categorized into, "no=0", and those using contraceptives were categorized into, "yes=1". Women were also asked the type of contraceptive they were currently using. Miscoding errors in the previous questions were corrected by using information from the question about the type of contraceptive being currently used.

Besides routine care some women may also require specialized care from qualified and competent professionals at a healthcare facility if they experience a life threatening complication during pregnancy, delivery, or postpartum. Women in this study were asked if they sought any care or treatment outside of the home for the LTC they had experienced during antepartum, and/or labor and delivery, and/or postpartum periods. 'Treatment outside home' in this study and in this socio-cultural context implies use of medical care at any health facility (a clinic, hospital, or merely the house of the healthcare professional) by either a trained or untrained provider (as defined above).

Treatment outside Home (maternal) - For each time period women were asked whether they sought treatment outside of the home for the LTC they experienced. Any woman may need treatment outside home for a LTC experienced during any of the three different time periods. The response options for all of the time periods were aggregated and categorized into two groups, "none=0", indicating treatment outside home not sought for LTC experienced during any time period, and "one or more=1", indicating treatment outside home sought for the LTC experienced during first (antepartum), second (labor and delivery), or third (postpartum) time period.

The association between caste and neonatal health was examined by using two sets of dependent variables, a) neonatal care, and b) utilization of neonatal healthcare services. Neonatal care was assessed through the receipt of aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth), and aseptic cord dressing (until cord fell off). At the same time neonatal healthcare services utilization was assessed by utilization of routine NNC and treatment outside home for LTC experienced either on the first day of birth and/or up to 28 days after birth, as reported by the woman for the neonate who was born following the pregnancy that occurred during Jan 1998-Jan 1999.

Neonatal Care

Aseptic Cord Cut- Women were asked if they used an aseptic instrument to cut the umbilical cord of the neonate or if the instrument they used was unsterilized. If broken glass or bangle, knife, old razor blade, scissors, sickle, or 'other' instruments were used that were baked in oven or burnt in fire, wiped with cloth only, not cleaned, or did not know how it was prepared and if the preparation happened more than a week or within a week of birth, or if timing of preparation was not known then the instrument was

considered “septic=0”. On the other hand if a new razor blade was used that was either washed in spirits or antiseptic, washed in water only, boiled in water, or boiled in water and antiseptic on the day of the delivery or after delivery then the instrument was considered “aseptic=1”.

Aseptic Cord Tie- Women were asked if they used an aseptic material to tie the umbilical cord of the neonate or if the material they used was unsterilized. If a material other than thread was used that was baked in oven, wiped with cloth only, not cleaned, or did not know how it was cleaned and if the cleaning happened more than a week or within a week of birth, or if timing of cleaning was not known then the material was considered “septic=0”. On the other hand if a thread was used that was either washed in alcohol or antiseptic, washed in water only, boiled in water, or boiled in water and antiseptic on the day of the delivery or after delivery then the thread was considered “aseptic=1”.

Aseptic Cord Dressing (at the day of birth) - Women were asked if they dressed the umbilical cord of the neonate with an aseptic substance or if the substance they used could cause sepsis. If the substance used was mustard oil, vermilion, ash, cow dung, or ‘other’ it was considered “septic=0”. On the other hand if the substance used was gentian violet, antibiotic medicine, or if nothing was used then it was considered “aseptic=1”.

Aseptic Cord Dressing (until cord fell) - Women were asked if they continued to dress the umbilical cord of the neonate with an aseptic substance until it fell or if the substance they used could cause sepsis. If the substance used was mustard oil, vermilion, ash, cow dung, cotton wool covering, or ‘other’ it was considered “septic=0”. On the other hand if the substance used was gentian violet, sulfa powder, antibiotic medicine, or belly binder then it was considered “aseptic=1”.

Neonatal Healthcare Services

Any Routine NNC- Women were asked if they sought routine NNC for the neonate during week 1, 2, 3, 4, weeks 4-6, after 6 weeks, during any other time period, or if they did not seek neonatal check-up. Since the primary interest of this study was to determine the utilization of routine NNC irrespective of the time period, the response options were sub-categorized into, "no=0", indicating, no utilization of routine NNC or utilization of care after fourth week, and "yes=1", indicating routine NNC during week 1, 2, 3, or 4. If the woman reported seeking routine NNC after 28 days of birth, the response options were categorized under "no=0". Similar questions on type of NNC provider and health facility visited for routine NNC were used to check for consistency of responses, correct data entry errors, and substitute for missing data.

Treatment outside Home (Neonatal) - Some neonates may develop life threatening complications that may require specialized care from qualified and competent professionals at a health facility. Women were asked if they had to seek any care or treatment outside of the home for the LTC the neonate had experienced either on the first day of the birth or up to 28 days. Any neonate may require treatment outside home for a LTC experienced during either time periods. The response options for both the time periods were aggregated and categorized into two groups, "none=0", indicating treatment outside home not sought for LTC experienced during either time period, and "one or more=1", indicating treatment outside home sought for the LTC experienced during any time periods (0-1 day or 2-28 days after birth).

Adjustment Variables

Gender of the Neonate -Gender of the neonate born following the pregnancy of 1998-99 was also known from the MAP dataset. Female neonates were coded as '0' and male neonates were coded as '1'.

Maternal Age- Women were asked how old they were (completed years) at their last birthday. This variable was used as a continuous variable.

Maternal Parity- Women were asked total number of term deliveries (still births, live births, or infant/child deaths) that they have had until the time of the interview. This variable was used as a continuous variable.

Number of Living Sons/Brothers- Sex composition of all living children (including the neonate in question) was determined from the total number of living children, the total number of living daughters, and the total number of living sons as reported by the women at the time of the interview. A new variable indicating total number of living sons/brothers was derived by counting the total number of living sons the woman had and subtracting this number by one if the neonate born was a male. The responses were used as a continuous variable.

SES Score- Since Maitha is a rural community, the majority of the people are not employed in regularly paying formal occupations; therefore the socioeconomic status of the families cannot be determined by annual/monthly household income. In MAP women were asked about the source of drinking water, type of toilet facilities, housing materials, ownership of certain appliances, vehicles, land, and livestock. Sibley et al.,[121] created a composite SES index. This composite SES Index was created by assigning weights to the asset variables (Appendix A). Weights were assigned after determining the relative potential of each asset to prevent maternal and neonatal deaths, e.g., tempo and tractor trol-

ley are better mode of transportation of the sick compared to a bicycle hence a higher weight was assigned. Later, for each household a consolidated SES score (addition of all scores) was computed. The distribution of consolidated score in the MAP data set was then examined. The SES scores ranged from 2 to 42, these SES scores were used as a continuous variable. SES indices are extensively used by researchers when data from rural population on household income are not available.

Maternal Literacy- Since the proportion of educated women in this part of India is very low, women were asked about their level of proficiency (easily, with difficulty, or not at all) with reading and understanding letters/mails/newspaper etc. These response options were recoded as "0=illiterate", "1=somewhat literate", and "2=literate or educated at 10^{th} grade or above". A similar question on highest level of education achieved was also asked and those who reported attending school at 10^{th} grade or above were considered 'literate'.

Data Analysis

Data Preparation- As a first step, duplicate data files for the five forms (Form 1, 2 A-D) were created and the original dataset was preserved. Duplicate data files were used for data cleaning, editing, transformation, and extraction. Variables that were not relevant for this study were deleted. Each data file had two sets of unique identifiers (case identification number and form number) for each study subject. All five data files were sorted in ascending order using the case identification number. Frequency distribution of the case identification number and the form number was reviewed to check for duplicate

(triplicate) unique identifiers and consistency of study sample. Form numbers were used to resolve this discrepancy, if inconsistency persisted then the socio-demographic data (age, date of pregnancy, religion, caste, etc.) were tallied. All discrepancies could be settled using these two strategies; frequency distribution of the case identification number and the form number indicated so.

Later, all five data files were checked for the consistency of variable names, labels, values, variable type, decimal places, and missing values. Data in each of the five data files were then sorted in ascending order using the case identification number. A single parent file, 'Caste', was created by merging the variables from the five data files. This data file had 627 study subjects, the total number of women who were pregnant during 1998 in the study area, as known from the MAP preliminary report.[121]

One hundred and forty five study subjects did not fulfill the inclusion-exclusion criteria for the proposed study. These study subjects were either not Hindu (N=35), did not had a full term gestation (N=57), or had a still-born neonate (N=16), or had multiple gestation (N=11), or died during pregnancy, labor, or during 42 days postpartum (N=8), or the neonate died during 1-28 days after birth (N=18), or the available interview was incomplete (N=4). These study subjects were deleted from the data file following the inclusion-exclusion criteria described above. After excluding the ineligible study subjects we had complete data for 482 women and 464 neonates.

The parent file, 'Caste', was split into 2 data files, one for mothers (N=482) and the other for the neonates (N=464). The frequency distributions of the unique identifiers as well as other variables were reviewed to rule out any errors.

Subsequently, each variable was assigned appropriate labels and values. Some variables had to be transformed and a few new variables were computed. Table 8 and the description of study variables were used for this purpose.

Data Cleaning and Editing- In the MAP questionnaire the responses were elicited through multiple questions. For example, the data on caste was available through two questions: 'What is your caste or traditional family occupation?' (main question); and 'What is the occupation of the head of the household?' (additional question). Although the responses to the 'main question' were given a priority and were considered the "gold standard" but the responses from the 'additional questions' were used to substitute for missing data and to resolve inconsistency in responses by cross-tabulating the main question with the additional question. Responses to 'additional questions' were also used to recode responses that were coded as 'other'. When an appropriate response could not be determined the data were coded as 'missing' and a valid value was assigned. Once the 'additional questions' had served their purpose of data cleaning and editing they were deleted. Data attrition due to exclusion of ineligible study subjects, skip patterns available in data dictionary, and variable coding from the MAP questionnaire were used to identify legitimate missing data.

Statistical Analysis

MAP data are available in SPSS 13.0.[127] This software was used for the analyses of the data for the proposed study. After data cleaning and editing the data file had 482 women and 464 neonates. Maternal and neonatal analyses were done separately. Results of step-by-step data analysis informed the data analysis strategy at every stage.

Univariate Analyses- The independent variable of primary interest, caste, was analyzed and modified in multiple ways to obtain most parsimonious and meaningful results. First, caste was analyzed with four nominal categories, SC, OBC, BC, and higher caste. Less than 2% of the study sample belonged to the OBC caste group therefore caste variable was analyzed as a categorical variable with three categories (SC, BC, and higher caste) after excluding this group from the analyses. Third, caste was dichotomized as 'lower caste' comprising of SC, OBC, and BC and 'upper caste' consisting of only the higher caste group. The dichotomized caste variable provided sufficient number of cases in each category to execute meaningful analyses. A univariate description of proportion of women and neonates in each caste category was calculated. Research question and hypotheses were tested for the dichotomized caste variable.

For continuous adjustment variables, maternal age, maternal parity, number of living sons/brothers, and socio-economic status score, measures of central tendency (mean, median, range, and standard deviation) were calculated. Maternal literacy was a categorical variable and gender of the neonate was dichotomous, for these variables proportions of women and neonates in each category were calculated. All dependent variables (any ANC, any TT, any IFA, trained birth attendant, any contraceptives, any PPC, treatment outside home (maternal), aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth), aseptic cord dressing (until cord fell off), any routine NNC, and treatment outside home (neonatal)) were dichotomous therefore proportion of women and neonates utilizing these services were also calculated.

Bivariate Analyses- Bivariate analyses of independent and adjustment variables were done to determine whether the socio-demographic factors significantly varied by

caste affiliation. Similarly, bivariate analyses of independent and dependent variables were done to determine whether the healthcare services utilization significantly varied by caste affiliation. Furthermore, bivariate analyses of adjustment and dependent variables were done to determine whether the socio-demographic factors varied between those who utilized a healthcare service and those who did not. Statistical significance was tested at $p<0.05$. Fisher's exact test (2-sided) was used if any cell count was less than 5.

Either ANOVA, or independent sample t-test (equal variance not assumed), or chi-square test were used for bivariate analyses. Post-hoc analyses were done either through the Scheffe post-hoc test (equal variance assumed) or by examining the adjusted residuals[128] in the contingency tables. The Scheffe post-hoc test helped to determine one caste group out of the four groups that had outstanding demographic characteristics if the adjustment variables were continuous. When the adjustment variables or the dependent variables were categorical the adjusted residuals were examined for the same purpose. Adjusted residuals indicate deviation of observed frequencies from the expected frequencies to determine which terms contribute most to the chi-square.[128] Cell in a contingency table with a high residual value was considered to be the caste group with outstanding characteristic.[128] Since maternal literacy was a three-level categorical variable therefore Mantel-Haenszel test for linear association or linear by linear association chi-square test was done to determine the linear association of this variable with the independent and the dependent variables.

Correlation analyses were done to identify potential multicollinearity between independent and adjustment variables. Caste, gender of the neonate, and maternal literacy were categorical variables, for these variables Spearman's rank correlation was done. For

all other continuous variables Pearson correlation was done. Statistical significance was tested at $p<0.05$ and $p<0.01$. If $r>0.70$, the variables were considered to be strongly correlated, indicating multicollinearity. Such strongly correlated independent and adjustment variables were either modified/transformed or excluded from further analyses. An exception, however, was made for the independent dichotomous variable of primary inertest, caste. If caste was strongly and significantly correlated with any other adjustment variable(s) then caste was retained (and not modified) but the correlated adjustment variable(s) was either modified/transformed or excluded.

Dependent variable, PPC, was removed from further analysis because more than one cell had <5 count. Correlation analysis showed that none of the adjustment variable was strongly correlated with either the independent variable or with each other therefore any adjustment variable whose bivariate test was $p<0.10$ and which had known biological and scientific significance was considered for multivariable modeling. Categorical variable, maternal literacy was dummy coded (0=illiterate, 1=somewhat literate, and 2=literate).

Multivariable Analyses- Multivariable logistic regression analyses, a mathematical modeling technique,[129, 130] was used to determine the odds of higher utilization of maternal and neonatal healthcare services by upper caste Hindu women/neonates compared to the lower caste Hindu women/neonates. Odds ratios indicated the direction and strength of association between the independent and the dependent variables. Multiple logistic regression models are described below.

$$\log it(p) = \ln\left[\frac{p_i}{1-p_i}\right] = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + \varepsilon_i$$

Where *p* is the binomial-outcome variable indicating the probability of utilization of services, α is the constant, β is the regression coefficient, *x* are the independent and adjustment variables, *i* are the study subjects, and ε is the error term.

Model for the first study aim, utilization of maternal healthcare services…

$$\ln\left[\frac{p}{1-p}\right] = \alpha + \beta_1 x_{i\ \text{caste}} + \beta_2 x_{i\ \text{adjustment variables}} + \varepsilon_i$$

Where, 'p' indicates the probability of utilization of maternal healthcare services.

Model for the second study aim, neonatal care and neonatal healthcare services utilization…

$$\ln\left[\frac{p}{1-p}\right] = \alpha + \beta_1 x_{i\ \text{caste}} + \beta_2 x_{i\ \text{adjustment variables}} + \varepsilon_i$$

Where, 'p' indicates the probability of neonatal care and utilization of neonatal healthcare services.

One-tailed test ($\alpha = 0.05$, $p<0.05$, 95% confidence interval (CI)) was used. The p-value and the 95% CI were used to determine the significance of the results. Odds ratio and 95% CI were calculated using the following formulae:

Odds Ratio: $OR = e^{\beta_{1-n}}$

95% Confidence Interval: $e^{\beta_{1-n} \pm 1.96 * SE(\beta_{1-n})}$

Where, 'n' represents the number of independent variables.

Three types of logistic regression models were built, unadjusted model (crude model for caste and all adjustment variables that had $p<0.10$ in bivariate analyses), full

model (adjusted model for caste, adjusted for the adjustment variables that had $p<0.10$ in bivariate analyses), and reduced/parsimonious model (adjusted model for caste, adjusted for the adjustment variables that had $p<0.05$ in the full model). Independent variable of primary interest, caste, was used in the full as well as in the adjusted model irrespective of its statistical significance. Method 'Enter' was used for model building. Statistical significance was tested at $p<0.05$. The unadjusted model tested the null hypotheses; there is no difference between upper and lower caste women/neonates with respect to the utilization of (specific) maternal/neonatal healthcare service. If this null hypothesis was rejected the full model was built to test the hypotheses; there is no difference between upper and lower caste women/neonates with respect to the utilization of (specific) maternal/neonatal healthcare service after adjusting for (a significant) socio-demographic factor(s). Reduced/parsimonious model was built to test the same hypotheses but to identify the socio-demographic factor(s) that had a strong ($p<0.05$) probability of influencing the association between caste and utilization of maternal/neonatal healthcare services.

Human Subjects

The study protocol involved secondary analyses of the MAP data. First, permission to use the MAP dataset was obtained from the Principal Investigator. In this dataset all personal identifiers were expunged to ensure confidentiality of the study subjects. Since there is no risk to study participants, the proposed study requested for 'Category 4 Exemption' (Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that sub-

jects cannot be identified, directly or through identifiers linked to the subjects) from the Institutional Review Board, University of Alabama at Birmingham. The exemption was sought after the study protocol was approved by the dissertation committee (Appendix B).

RESULTS

The research questions of this study were answered through the secondary analysis of the MAP data. Data were analyzed for 482 Hindu women and 464 live born singleton Hindu neonates of Maitha, UP, India. Results of data analyses are presented here in two sections: a) maternal healthcare services utilization; and b) neonatal care and neonatal healthcare services utilization. Data were analyzed and results are presented in detail for two caste groups. Data analysis for four and three caste groups (excluding OBC group) are presented in the appendices and briefly discussed. Results are supported with data in the tables in each section. A brief summary of results is presented at the end of each section.

Maternal Healthcare Services Utilization

In the following section, first, the socio-demographic characteristics of the women are presented, second, data on maternal healthcare services utilization are made available, third, results of multicollinearity analysis are presented, and finally, the results of multivariable analysis are presented to answer the study hypotheses. The socio-demographic characteristics and healthcare services utilization data are stratified by caste affiliation. Each section concludes with a brief summary of results.

Socio-demographic Characteristics of Hindu Women

In this sample of 482 Hindu women, 39.0% women were SC, 2.0% were OBC, 43.3% were BC, and 15.5% were higher caste (Table 9). Hindu women were 15-45 years old and the median age, 27.0 years (mean: 27.3 yrs, SD: 5.1), indicated low maternal age among the women of Maitha. On an average, Hindu women in this sample had a parity of 3.6 (median: 3.0, range: 1-12, SD: 2.2) and at least one living son (median: 1.0, range: 0-6, SD: 1.1). High parity and large number of living sons at young maternal age suggest a low status of women in this study population. The SES score – a composite index of household assets such as source of drinking water, type of toilet, housing materials, consumer durables, vehicles, land, and livestock – ranged from 2-42 and on an average Hindu women had an SES score of 9.6 (median: 9.0, SD: 5.3) indicating lower socio-economic status. Only one-third (33.6%) Hindu women were literate and as many as 56.4% women were illiterate.

Socio-demographic Characteristics of Hindu Women by Caste Affiliation

Social status of lower caste Hindu women was poorer compared to the upper caste Hindu women. When the sample was split into two groups, majority of the women (84.4%) belonged to the lower caste group which consisted of SC, OBC, and BC women (Table 9). When compared to the SC, OBC, and BC women (or lower caste women), the maternal age (mean: 26.5 years, SD: 4.4), parity (mean: 3.1, SD: 1.6), and number of living sons (mean: 0.6, SD: 0.7) among the upper caste women were lowest, $p<0.05$. Upper caste women also had a higher SES score (mean: 11.8, SD: 4.7) and 62.6% of them were literate compared to the SC, OBC, and BC women (or lower caste women), $p<0.001$. Ma-

Table 9. Demographic characteristics of all Hindu women stratified by four and two caste categories, who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

		Four Caste Categories					Two Caste Categories		
	All (N=482)	**Higher caste (N=75)**	**Other backward caste (N=10)**	**Backward class (N=209)**	**Scheduled caste (N=188)**	**p-value**	**Upper caste (N=75)**	**Lower caste (N=407)**	**p-value**
Maternal age (completed years)									
Mean	27.35	26.52	32.70	27.19	27.57		26.52	27.50	
Median	27.00	26.00	32.50	27.00	27.00		26.00	27.00	
Standard Deviation	5.13	4.49	3.88	5.26	5.15	0.004*	4.49	5.24	0.093
Maternal parity									
Mean	3.68	3.15	6.40	3.56	3.88		3.15	3.78	
Median	3.00	3.00	6.50	3.00	3.00		3.00	3.00	
Standard Deviation	2.22	1.60	2.54	2.24	2.29	<0.001*	1.60	2.31	0.004*
Number of living sons									
Mean	0.99	0.67	2.20	1.02	1.01		0.67	1.04	
Median	1.00	0.00	2.00	1.00	1.00		0.00	1.00	
Standard Deviation	1.13	0.77	2.09	1.13	1.13	<0.001*	0.77	1.17	0.001*
Socio-economic status score									
Mean	9.62	11.81	10.90	10.19	8.06		11.81	9.22	
Median	9.00	11.00	9.50	9.00	7.00		11.00	8.00	
Standard Deviation	5.32	4.77	4.77	5.79	4.53	<0.001*	4.77	5.32	<0.001*
Maternal literacy									
Literate	162 (33.60%)	47 (62.66%)	0	80 (38.27%)	35 (18.61%)		47 (62.66%)	115 (28.25%)	
Somewhat literate	48 (9.95%)	11 (14.66%)	0	19 (9.09%)	18 (9.57%)		11 (14.66%)	37 (9.09%)	
Illiterate	272 (56.43%)	17 (22.66%)	10 (100%)	110 (52.63%)	135 (71.80%)	<0.001* <0.001*†	17 (22.66%)	255 (62.65%)	<0.001* <0.001*†

Data missing for only one (0.2%) woman for maternal age and socio-economic status score. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

-jority of the lower caste women were either illiterate or somewhat literate. A linear trend between maternal literacy and caste was indicated, $p<0.001$.

Scheffe post-hoc test showed that the demographic characteristics of the OBC women were significantly different from the women of the other three caste groups with respect to maternal age, parity, and number of living sons (Appendix D). Examination of adjusted residuals indicated that greater proportion of illiterate mothers belonged to SC group compared to the other 3 caste groups (Appendix D). Data were further analyzed after excluding the OBC women (Appendix C); upper caste women had better socio-demographic characteristics compared to the women of the lower caste groups. Post-hoc analyses were repeated after excluding OBC women from the analyses. The Scheffe post-hoc test showed that the number of living sons among the higher caste women was significantly different from the women of the other two caste groups (Appendix E).

In summary, lower caste Hindu women had higher maternal age, parity, number of living sons, lower SES score, and fewer of them were literate compared to the upper caste Hindu women.

Maternal Healthcare Services Utilization among Hindu Women

Utilization of maternal healthcare services in this study was measured through the utilization of any ANC, any TT, any IFA, presence of trained birth attendant, any PPC, current use of contraceptives, and treatment outside home. Maternal healthcare services utilization among Hindu women in Maitha was very low (Table 10). Only 10.1% Hindu women utilized ANC, 49.3% received TT either during the pregnancy of 1998-99 or the previous pregnancy, 14.9% ingested IFA, as few as 3.7% women were attended by

Table 10. Maternal healthcare services utilization by two caste groups for the women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=482)	**Upper caste (N=75)**	**Lower caste (N=407)**	**p-value**
Any antenatal care				
Yes	49 (10.16%)	15 (20.00%)	34 (8.35%)	
No	431 (89.41%)	60 (80.00%)	371 (91.15%)	
				0.002§
Any tetanus toxoid*				
Yes	238 (49.37%)	51 (68.00%)	187 (45.94%)	
No	244 (50.62%)	24 (32.00%)	220 (54.05%)	
				<0.001§
Any Iron Folic Acid				
Yes	72 (14.93%)	16 (21.33%)	56 (13.75%)	
No	410 (85.06%)	59 (78.66%)	351 (86.24%)	
				0.091
Trained birth attendant				
Yes	18 (3.73%)	8 (10.66%)	10 (2.45%)	
No	460 (95.43%)	66 (88.00%)	394 (96.80%)	
				0.001§
Any postpartum care				
Yes	5 (1.03%)	0	5 (1.22%)	
No	472 (99.00%)	75 (100.00%)	397 (97.54%)	
				1.000
Contraceptive†				
Yes	39 (8.09%)	12 (16.00%)	27 (6.63%)	
No	427 (88.58%)	61 (81.33%)	366 (89.92%)	
				0.007§
Treatment outside home‡				
Yes	31 (6.43%)	4 (5.33%)	27 (6.63%)	
No	451 (93.56%)	71 (94.66%)	380 (93.33%)	
				0.803

*Either during the pregnancy of 1998-99 or previous pregnancy. †At the time of the interview. ‡For a life threatening complication experienced either during pregnancy, labor and delivery, or postpartum. Data were missing for 2 (0.4%) women for any antenatal care, 4 (0.8%) women for trained birth attendant, 5 (1%) women for any postpartum care, and 16 (3.3%) women for contraceptive use. §$p<0.05$.

trained birth attendant, fewer (1.0%) utilized PPC, 8.3% used contraceptives at the time of the interview, and treatment outside home for a LTC experienced by the woman either during pregnancy, childbirth, or postpartum was sought by only 6.4% women.

Maternal Healthcare Services Utilization and Caste Affiliation

When the data were stratified by caste, greater proportion of those who utilized most of the maternal healthcare services were upper caste women (Table 10). Majority of the upper caste women utilized ANC (20.0% vs. 8.3%), TT (68.0% vs. 45.9%), IFA (21.3% vs. 13.7%), trained birth attendant (10.6% vs. 2.4%), and contraceptives (16.0% vs. 6.6%), compared to the lower caste women, $p<0.10$.

Similar results were found when data were analyzed for four caste groups and when OBC were excluded from the analysis (Appendix F, G). Examination of adjusted residuals indicated that greater proportion of higher caste women utilized ANC, TT, trained birth attendant, and contraceptives compared to the women in other caste groups (Appendix H, I).

In summary, greater proportion of upper caste women had utilized ANC, TT, IFA, trained birth attendant, and contraceptives compared to the lower caste women. There was no difference between the two caste groups with respect to the utilization of PPC and seeking treatment outside home.

Maternal Healthcare Services Utilization and Socio-demographic Factors

Hindu women who utilized ANC and TT were younger, had lower parity, did not have any living son, had a higher SES score, and greater proportion of them were literate compared to the Hindu women who did not utilize ANC and TT, $p<0.05$ (Table 11). A linear trend between maternal literacy and ANC utilization and TT receipt was also indic-

Table 11. Demographic characteristics and antenatal care and tetanus toxoid utilization for the women who w ere pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Antenatal Care				Tetanus Toxoid			
	All (N=480)	**Yes (N=49)**	**No (N=431)**	**p-value**	**All (N=482)**	**Yes (N=238)**	**No (N=244)**	**p-value**
Maternal age (completed years)								
Mean	27.37	26.00	27.52		27.35	26.56	28.12	
Median	27.00	25.00	27.00		27.00	25.00	29.00	
Standard Deviation	5.14	4.82	5.15	0.044*	5.13	4.75	5.38	0.001*
Maternal parity								
Mean	3.69	2.94	3.77		3.68	3.34	4.01	
Median	3.00	2.00	3.00		3.00	3.00	3.50	
Standard Deviation	2.22	1.79	2.25	0.004*	2.22	2.03	2.35	0.001*
Number of living sons								
Mean	0.99	0.45	1.05		0.99	0.87	1.09	
Median	1.00	0.00	1.00		1.00	1.00	1.00	
Standard Deviation	1.13	0.70	1.15	<0.001*	1.13	1.05	1.19	0.032*
Socio-economic status score								
Mean	9.63	11.37	9.43		9.62	10.47	8.79	
Median	9.00	10.00	8.00		9.00	9.00	8.00	
Standard Deviation	5.32	6.10	5.20	0.037*	5.32	5.86	4.59	0.001*
Maternal literacy								
Literate	162 (33.75%)	26 (53.06%)	136 (31.55%)		162 (33.60%)	101 (42.43%)	61 (25.00%)	
Somewhat literate	48 (10.00%)	6 (12.24%)	42 (9.74%)		48 (9.95%)	21 (8.82%)	27 (11.06%)	
Illiterate	270 (56.25%)	17 (34.69%)	253 (58.70%)	0.004*	272 (56.43%)	116 (48.73%)	156 (63.93%)	<0.001*
				0.005*†				<0.001†

Data were missing for only 2 (0.4%) women for antenatal care utilization. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

cated, $p<0.01$.

Hindu women who ingested IFA had lower parity, did not have any living son, had a higher SES score, and greater proportion of them were literate compared to the Hindu women who did not ingest IFA, $p<0.05$ (Table 12). A linear trend between maternal literacy and IFA ingestion was also indicated, $p<0.01$. Similarly, Hindu women who were attended by a trained birth attendant were younger, had lower parity, did not have any living son, had a higher SES score, and greater proportion of them were literate compared to the Hindu women who were not attended by a trained birth attendant, $p<0.10$. A linear trend between maternal literacy and presence of trained birth attendant was also indicated, $p<0.10$ (Table 12).

Greater proportion of Hindu women who used contraceptives were literate compared to the Hindu women who did not use contraceptives, $p<0.01$ (Table 13). A linear trend between maternal literacy and contraceptive use was also indicated, $p<0.01$.

As expected, Hindu women who sought treatment outside home had a higher SES score and they did not have any living son compared to the Hindu women who sought treatment outside home, $p<0.05$ (Table 13).

In summary, maternal healthcare services utilization significantly varied by caste affiliation. Moreover, women who utilized these maternal healthcare services were also younger, had lower parity, fewer number of living sons, higher SES score, and greater proportion of them were literate compared to the women who did not utilize these maternal healthcare services.

Table 12. Demographic characteristics and iron folic acid ingestion and presence of trained birth attendant for the women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

		Iron Folic Acid			Trained Birth Attendant			
	All (N=482)	Yes (N=72)	No (N=410)	p-value	All (N=478)	Yes (N=18)	No (N=460)	p-value
Maternal age (completed years)								
Mean	27.35	26.82	27.44		27.37	25.28	27.46	
Median	27.00	26.00	27.00		27.00	23.50	27.00	
Standard Deviation	5.13	5.20	5.12	0.348	5.11	4.25	5.13	0.048*
Maternal parity								
Mean	3.68	3.14	3.78		3.69	2.28	3.75	
Median	3.00	3.00	3.00		3.00	2.00	3.00	
Standard Deviation	2.22	1.87	2.27	0.011*	2.22	1.70	2.22	0.002*
Number of living sons								
Mean	0.99	0.76	1.02		0.99	0.22	1.02	
Median	1.00	0.00	1.00		1.00	0.00	1.00	
Standard Deviation	1.13	0.89	1.16	0.032*	1.12	0.54	1.13	<0.001*
Socio-economic status score								
Mean	9.62	11.85	9.23		9.65	11.72	9.57	
Median	9.00	10.00	8.00		9.00	11.50	8.00	
Standard Deviation	5.32	6.97	4.88	0.003*	5.33	4.62	5.34	0.069
Maternal literacy								
Literate	162 (33.60%)	37 (51.38%)	125 (30.48%)		160 (33.47%)	11 (61.11%)	149 (32.39%)	
Somewhat literate	48 (9.95%)	7 (9.72%)	41 (10.00%)		48 (10.04%)	1 (5.55%)	47 (10.21%)	
Illiterate	272 (56.43%)	28 (38.88%)	244 (59.51%)	0.002*	270 (56.48%)	6 (33.33%)	264 (57.39%)	0.040*
				0.002*†				0.050†

Data were missing for only 4 (0.8%) women for the presence of trained birth attendant. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

Table 13. Demographic characteristics and contraceptive utilization and treatment outside home for the women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Contraceptives				Treatment Outside Home			
	All (N=466)	**Yes (N=39)**	**No (N=427)**	**p-value**	**All (N=482)**	**Yes (N=31)**	**No (N=451)**	**p-value**
Maternal age (completed years)								
Mean	27.26	26.95	27.29		27.35	26.32	27.42	
Median	27.00	26.00	27.00		27.00	25.00	27.00	
Standard Deviation	5.14	4.32	5.21	0.642	5.13	4.92	5.15	0.239
Maternal parity								
Mean	3.65	3.62	3.66		3.68	3.26	3.71	
Median	3.00	3.00	3.00		3.00	3.00	3.00	
Standard Deviation	2.21	1.78	2.25	0.896	2.22	2.12	2.23	0.260
Number of living sons								
Mean	0.97	1.18	0.95		0.99	0.65	1.01	
Median	1.00	1.00	1.00		1.00	0.00	1.00	
Standard Deviation	1.12	1.09	1.12	0.220	1.13	0.83	1.14	0.029*
Socio-economic status score								
Mean	9.60	10.72	9.49		9.62	8.23	9.72	
Median	9.00	9.00	8.00		9.00	8.00	9.00	
Standard Deviation	5.31	5.16	5.32	0.165	5.32	3.72	5.45	0.043*
Maternal literacy								
Literate	160 (34.33%)	22 (56.41%)	138 (32.31%)		162 (33.60%)	13 (41.93%)	149 (33.03%)	
Somewhat literate	47 (10.08%)	6 (15.38%)	41 (9.60%)		48 (9.95%)	4 (12.90%)	44 (9.75%)	
Illiterate	259 (55.57%)	11 (28.20%)	248 (58.07%)	0.002*	272 (56.43%)	14 (45.16%)	258 (57.20%)	0.424
				0.001*†				0.428†

Data were missing for 16 (3.3%) women for contraceptive utilization. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

Multicollinearity Analysis for Socio-demographic Factors

Results of correlation analysis below show that in this sample of Hindu women the correlation between caste and SES score was very weak (r=0.21, p<0.01) although positive and significant, so was the correlation with maternal literacy (r=0.29, p<0.01) (Table 14). Maternal age and maternal parity were inversely correlated with caste, however, the correlation was statistically insignificant. Caste and number of living sons were also inversely correlated (r=-0.10, p<0.05) but the correlation was weak. Caste was not strongly correlated with any socio-demographic factor.

Table 14. Multicollinearity analysis of socio-demographic characteristics of the women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	1*	2	3	4	5	6*
1. Caste*	1.0					
2. Maternal age (completed years)	-0.06	1.0				
3. Maternal parity	-0.07	0.70‡	1.0			
4. Number of living sons	-0.10†	0.51‡	0.66‡	1.0		
5. Socio-economic status score	0.21‡	-0.06	-0.07	-0.01	1.0	
6. Maternal literacy*	0.29‡	-0.27‡	-0.30‡	-0.13‡	0.28‡	1.0

*Spearman's Rank Correlation. Pearson Correlation for maternal age, maternal parity, number of living sons, and socio-economic status score. †p<0.05, ‡p<0.01. Data were missing for a maximum of two (0.4%) women.

Correlation between maternal age and maternal parity (r=0.70, p<0.01) was strong and statistically significant but multicollinearity was not indicated (Table 14). Correlation between maternal age and number of living sons (r=0.51, p<0.01) was positive and statistically significant but moderate. Similarly, maternal parity and number of living sons were positively but moderately correlated (r=0.66, p<0.01). Maternal literacy was positively but weakly correlated with caste (r=0.29, p<0.01) and SES score (r=0.28, p<0.01). As expected, maternal literacy was negatively correlated with maternal age (r=-0.27,

p<0.01), maternal parity (r=-0.30, p<0.01), and number of living sons (r=-0.13, p<0.01), but the correlations were very weak.

Multicollinearity analysis results indicated that the correlation between almost all socio-demographic variables was weak to moderate. Multicollinearity was not indicated.

Multivariable Analyses and Maternal Healthcare Services Utilization

Antenatal Care

Upper caste women were almost three times (ORc=2.72, 95% CI: 1.40, 5.30, p<0.01) more likely to utilize ANC than lower caste women (Table 15). The likelihood of ANC utilization reduced to almost 20% with every unit increase in maternal parity (ORc=0.81, 95% CI: 0.69, 0.96, p<0.05) and almost 50% (ORc=0.49, 95% CI: 0.32, 0.74, p<0.01) with every unit increase in number of living sons. On the other hand, the likelihood of ANC utilization increased 5% (ORc=1.05, 95% CI: 1.01, 1.11, p<0.05) with every unit increase in SES score and as much as 184% (ORc=2.84, 95% CI: 1.49, 5.42, p<0.01) for the women who were literate compared to those who were illiterate. Upper caste women were more likely to utilize ANC compared to the lower caste women. Null hypothesis, H_{01}, there is no difference between upper and lower caste women with respect to ANC utilization, was rejected.

Caste, maternal age, maternal parity, number of living sons, SES score, and maternal literacy were eligible (p<0.10) (Table 11) for adjustment in the full model. In the reduced model only one variable, number of living sons (p<0.05), was eligible for adjustment. After adjusting for number of living sons, we found that the upper caste women

Table 15. Logistic regression analyses indicating utilization of antenatal care services by upper caste women compared to lower caste women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			**Full Model (p<0.10)***			**Reduced Model (p<0.05)†**		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00			1.00			1.00		
Upper caste	**2.72**	**1.40, 5.30**	**0.003**	1.80	0.87, 3.72	0.110	**2.39**	**1.21, 4.71**	**0.011**
Maternal age (completed years)	0.94	0.88, 1.00	0.053	1.00	0.92, 1.09	0.900			
Maternal parity	**0.81**	**0.69, 0.96**	**0.015**	1.04	0.82, 1.33	0.721			
Number of living sons	**0.49**	**0.32, 0.74**	**0.001**	**0.49**	**0.30, 0.80**	**0.004**	**0.50**	**0.33, 0.76**	**0.001**
Socio-economic status score	**1.05**	**1.01, 1.11**	**0.018**	1.03	0.98, 1.09	0.165			
Maternal literacy									
Illiterate	1.00			1.00					
Somewhat literate	2.12	0.79, 5.70	0.134	1.74	0.62, 4.88	0.288			
Literate	**2.84**	**1.49, 5.42**	**0.002**	1.89	0.89, 4.01	0.093			

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Number in bold indicate statistical significance, p<0.05. Data were missing for 2 (0.4%) women.

were more than twice (ORa=2.39, 95% CI: 1.21, 4.71, p<0.05) as likely to utilize ANC compared to the lower caste women (Table 15). The likelihood of ANC utilization reduced to 50% (ORa=0.50, 95% CI: 0.33, 0.76, p<0.01) with every unit increase in number of living sons after adjusting for caste. Upper caste women were more likely to utilize ANC compared to the lower caste women when number of living sons was adjusted for; consequently, we rejected the null hypothesis, H_{08}.

Tetanus Toxoid

Results of the logistic regression analysis showed that upper caste women were more likely to receive TT compared to the lower caste women (Table 16).

Upper caste women were 2.5 times (ORc=2.50, 95% CI: 1.48, 4.21, p<0.01) more likely to receive TT than lower caste women. The likelihood of TT receipt reduced to 6% with every unit increase in maternal age (ORc=0.94, 95% CI: 0.90, 0.97, p<0.01) and almost 15% with every unit increase in maternal parity (ORc=0.87, 95% CI: 0.80, 0.94, p<0.01) and number of living sons (ORc=0.83, 95% CI: 0.71, 0.98, p<0.05). On the other hand, the likelihood of TT receipt increased 6% (ORc=1.06, 95% CI: 1.02, 1.10, p<0.01) with every unit increase in SES score and as much as 122% (ORc=2.22, 95% CI: 1.49, 3.31, p<0.01) for the women who were literate compared to those who were illiterate. Upper caste women were 2.5 times more likely to receive TT compared to the lower caste women. Null hypothesis, H_{02}, there is no difference between upper and lower caste women with respect to receipt of TT, was rejected.

Caste, maternal age, maternal parity, number of living sons, SES score, and maternal literacy were eligible (p<0.10) (Table 11) for adjustment in the full model. In the reduced model only one variable, SES score (p<0.05), was eligible for adjustment. After

Table 16. Logistic regression analyses indicating receipt of tetanus toxoid by upper caste women compared to lower caste women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05) †		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00			1.00			1.00		
Upper caste	**2.50**	**1.48, 4.21**	**0.001**	**1.95**	**1.11, 3.43**	**0.019**	**2.19**	**1.28, 3.73**	**0.004**
Maternal age (completed years)	**0.94**	**0.90, 0.97**	**0.001**	0.96	0.91, 1.01	0.142			
Maternal parity	**0.87**	**0.80, 0.94**	**0.001**	0.95	0.83, 1.09	0.519			
Number of living sons	**0.83**	**0.71, 0.98**	**0.033**	1.01	0.81, 1.27	0.880			
Socio-economic status score	**1.06**	**1.02, 1.10**	**0.001**	**1.04**	**1.00, 1.08**	**0.017**	**1.05**	**1.01, 1.09**	**0.004**
Maternal literacy									
Illiterate	1.00			1.00					
Somewhat literate	1.04	0.56, 1.94	0.887	0.76	0.39, 1.45	0.408			
Literate	**2.22**	**1.49, 3.31**	**<0.001**	1.43	0.91, 2.23	0.117			

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Number in bold indicate statistical significance, p<0.05. Data were not missing for any woman.

adjusting for SES score, we found that the upper caste women were more than twice (ORa=2.19, 95% CI: 1.28, 3.73, p<0.01) as likely to receive TT compared to the lower caste women when SES score was adjusted for (Table 16). The likelihood of TT receipt increased 5% (ORc=1.05, 95% CI: 1.01, 1.09, p<0.01) with every unit increase in SES score after adjusting for caste. Upper caste women were more likely to receive TT compared to the lower caste women when SES score was adjusted for; consequently, we rejected the null hypothesis, H_{09}.

Iron Folic Acid

There was no difference between the upper and lower caste women with respect to IFA ingestion; we failed to reject null hypothesis H_{03}. However, SES score was found to be significant determinant of IFA ingestion. The likelihood of IFA ingestion increased 8% (ORc=1.08, 95% CI: 1.03, 1.12, p<0.01) with every unit increase in SES score (Table 17).

Trained Birth Attendant

Presence of trained birth attendant was strongly associated with the caste affiliation of Hindu women. Upper caste women were almost 5 times (ORc=4.77, 95% CI: 1.81, 12.54, p<0.01) more likely to be attended by a trained attendant at birth than lower caste women (Table 18). The likelihood of presence of trained birth attendant reduced to almost 40% with every unit increase in maternal parity (ORc=0.61, 95% CI: 0.43, 0.88, p<0.01) and as much as 75% with every unit increase in number of living sons (ORc=0.26, 95% CI: 0.10, 0.69, p<0.01). On the other hand, the likelihood of presence of trained birth attendant increased more than thrice (ORc=3.24, 95% CI: 1.17, 8.96, p<0.05) for the women who were literate compared to those who were illiterate. Upper

Table 17. Logistic regression analyses indicating ingestion of iron folic acid by upper caste women compared to lower caste women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			**Full Model (p<0.10)***			**Reduced Model (p<0.05) †**		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00			1.00			1.00		
Upper caste	1.70	0.91, 3.16	0.094	1.09	0.56, 2.14	0.785	1.13	0.58, 2.19	0.719
Maternal age (completed years)									
Maternal parity	**0.86**	**0.76, 0.98**	**0.026**	0.94	0.79, 1.12	0.534			
Number of living sons	0.79	0.61, 1.02	0.073	0.90	0.64, 1.26	0.540			
Socio-economic status score	**1.08**	**1.03, 1.12**	**<0.001**	**1.06**	**1.02, 1.11**	**0.004**	**1.06**	**1.02, 1.11**	**0.004**
Maternal literacy									
Illiterate	1.00			1.00			1.00		
Somewhat literate	1.48	0.61, 3.63	0.383	1.25	0.50, 3.12	0.623	1.31	0.53, 3.26	0.551
Literate	**2.57**	**1.50, 4.40**	**0.001**	**1.86**	**1.02, 3.40**	**0.043**	**2.07**	**1.16, 3.68**	**0.013**

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Number in bold indicate statistical significance, p<0.05. Data were not missing for any woman.

Table 18. Logistic regression analyses indicating presence of trained birth attendant for upper caste women compared to lower caste women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05) †		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00			1.00			1.00		
Upper caste	**4.77**	**1.81, 12.54**	**0.002**	**3.49**	**1.18, 10.32**	**0.024**	**4.77**	**1.81, 12.54**	**0.002**
Maternal age (completed years)	0.91	0.82, 1.01	0.080	1.05	0.91, 1.12	0.473			
Maternal parity	**0.61**	**0.43, 0.88**	**0.008**	0.74	0.45, 1.21	0.234			
Number of living sons	**0.26**	**0.10, 0.69**	**0.007**	0.35	0.12, 1.02	0.056			
Socio-economic status score	1.06	0.98, 1.13	0.096	1.02	0.94, 1.11	0.558			
Maternal literacy									
Illiterate	1.00			1.00					
Somewhat literate	0.93	0.11, 7.95	0.952	0.72	0.08, 6.57	0.774			
Literate	**3.24**	**1.17, 8.96**	**0.023**	1.52	0.46, 4.98	0.486			

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Number in bold indicate statistical significance, p<0.05. Data were missing for 4 (0.8%) women.

caste women were more likely to be attended by a trained attendant at birth than lower caste women. Null hypothesis, H_{04}, there is no difference between upper and lower caste women with respect to presence of trained birth attendant, was rejected.

Caste, maternal age, maternal parity, number of living sons, SES score, and maternal literacy were eligible ($p<0.10$) for adjustment in the full model (Table 12). No socio-demographic factors were eligible for adjustment in the reduced model. Upper caste women were almost five times more likely to be attended by a trained birth attendant compared to the lower caste women.

Contraceptives

According to the results of the logistic regression analysis contraceptive utilization at the time of the interview was strongly associated with the caste affiliation of Hindu women. Upper caste women were more than 2.5 times (ORc=2.66, 95% CI: 1.28, 5.54, $p<0.01$) more likely to use contraceptives than lower caste women (Table 19). At the same time, the likelihood of contraceptive use increased more than thrice for the women who were literate (ORc=3.59, 95% CI: 1.69, 7.63, $p<0.01$) and somewhat literate (ORc=3.29, 95% CI: 1.15, 9.41, $p<0.05$) compared to those who were illiterate. Upper caste women were more likely to use contraceptives than lower caste women. Null hypothesis, H_{06}, there is no difference between upper and lower caste women with respect to contraceptive utilization, was rejected.

Only maternal literacy was eligible ($p<0.10$) (Table 13) for adjustment in the full model and the reduced model. After adjusting for maternal literacy, the likelihood of utilization of contraceptives did not vary by caste (ORa=1.81, 95% CI: 0.84, 3.92, $p=0.1$) (Table 19). The likelihood of contraceptive use increased almost three times for the

Table 19. Logistic regression analyses indicating utilization of contraceptives by upper caste women compared to lower caste women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			**Full Model (p<0.10)***			**Reduced Model (p<0.05)†**		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00			1.00			1.00		
Upper caste	**2.66**	**1.28, 5.54**	**0.009**	1.81	0.84, 3.92	0.128	1.81	0.84, 3.92	0.128
Maternal age (completed years)									
Maternal parity									
Number of living sons									
Socio-economic status score									
Maternal literacy									
Illiterate	1.00			1.00			1.00		
Somewhat literate	**3.29**	**1.15, 9.41**	**0.026**	**2.97**	**1.03, 8.60**	**0.044**	**2.97**	**1.03, 8.60**	**0.044**
Literate	**3.59**	**1.69, 7.63**	**0.001**	**3.07**	**1.40, 6.75**	**0.005**	**3.07**	**1.40, 6.75**	**0.005**

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Number in bold indicate statistical significance, p<0.05. Data were missing for 16 (3.3%) women.

women who were literate (ORa=2.97, 95% CI: 1.03, 8.60, $p<0.05$) and somewhat literate (ORa=3.07, 95% CI: 1.40, 6.75, $p<0.05$) compared to those who were illiterate after adjusting for caste. The likelihood of utilization of contraceptives did not vary by caste after adjusting for maternal literacy. We failed to reject the null hypothesis, H_{013}.

Logistic regression analysis showed that there was no difference between the upper and lower caste women with respect to seeking treatment outside home for a LTC experienced either during pregnancy, childbirth, or postpartum as lower caste women (Table 20). We failed to reject the null hypothesis H_{07}. None of the socio-demographic variables were a significant determinant of seeking treatment outside home.

In summary, we found that all components of maternal healthcare services were poorly utilized by Hindu women in Maitha, UP, India. Moreover, utilization of ANC, TT, trained birth attendant, and contraceptives was significantly higher among upper caste women compared to the lower caste women. Besides caste, number of living sons, SES score, and maternal literacy appeared to be strong determinants of maternal healthcare services utilization.

Neonatal Care and Neonatal Healthcare Services Utilization

In this section first the socio-demographic characteristics of the neonates are described, followed by description of neonatal care and the utilization of neonatal healthcare services, next results of multicollinearity analyses are presented, and finally the results of multivariable analysis answer the study hypotheses mentioned above. The socio-demographic characteristics and neonatal care as well as neonatal healthcare services

Table 20. Logistic regression analyses indicating treatment outside home sought by upper caste women compared to lower caste women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			**Full Model (p<0.10)***			**Reduced Model (p<0.05)†**		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00			1.00			1.00		
Upper caste	0.79	0.26, 2.33	0.674	0.85	0.28, 2.59	0.780	0.85	0.28, 2.59	0.780
Maternal age (completed years)									
Maternal parity									
Number of living sons	0.70	0.46, 1.05	0.086	0.68	0.45, 1.04	0.077	0.68	0.45, 1.04	0.077
Socio-economic status score	0.93	0.86, 1.01	0.130	0.93	0.86, 1.02	0.144	0.93	0.86, 1.02	0.144
Maternal literacy									
Illiterate									
Somewhat literate									
Literate									

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Number in bold indicate statistical significance, p<0.05. Data were not missing for any women.

utilization data are stratified by caste affiliation. Each section concludes with a brief summary of results.

Socio-demographic Characteristics of the Hindu Neonates

In this sample of 464 live born singleton Hindu neonates, 39.6% neonates were SC, 2.1% were OBC, 42.8% were BC, and 15.3% were higher caste (Table 21). Half (48.4%) of the neonates were female and the other half were male. Mothers of these neonates were 15-45 years old and the median age was 27.0 years (mean: 27.3 yrs, SD: 5.1). On an average these mothers had a parity of 3.6 (median: 3.0, range: 1-12, SD: 2.2) and the neonates had at least one living brother (median: 1.0, range: 0-6, SD: 1.1). On an average neonates belonged to families with an SES score of 9.5 (median: 9.0, range: 2-42, SD: 5.2) indicating lower socio-economic status. Mothers of only one-third (33.6%) neonates were literate.

Socio-demographic Characteristics of Hindu Neonates by Caste Affiliation

Social status of mothers of lower caste neonates was poorer compared to the mothers of the upper caste neonates. When sample was split into two groups, majority of the neonates (84.6%) belonged to the lower caste group which consisted of SC, OBC, and BC neonates (Table 21). When compared to the lower caste group (SC, OBC, BC) the higher caste mothers were younger, had lower parity, higher SES score, and higher caste neonates did not had a living brother, $p<0.10$. Furthermore, as many as 61.9% upper caste mothers were literate whereas only 28.4% lower caste mothers were literate; a linear trend between maternal literacy and caste was also indicated, $p<0.001$.

Table 21. Demographic characteristics of the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by four and two caste groups

		Four Caste Categories					Two Caste Categories		
	All (N=464)	**Higher caste (N=71)**	**Other backward caste (N=10)**	**Backward class (N=199)**	**Scheduled caste (N=184)**	**p-value**	**Upper caste (N=71)**	**Lower caste (N=393)**	**p-value**
Gender of the neonate									
Male	239 (51.50%)	38 (53.52%)	6 (60.00%)	97 (48.74%)	96 (52.17%)		38 (53.52%)	201 (51.14%)	
Female	225 (48.49%)	33 (46.47%)	4 (40.00%)	102 (51.25%)	86 (46.73%)	0.744	33 (46.47%)	192 (48.45%)	0.712
Maternal age (completed years)									
Mean	27.35	26.37	32.70	26.20	27.58		26.37	27.53	
Median	27.00	26.00	32.50	27.00	27.00		26.00	27.00	
Standard Deviation	5.11	4.44	3.88	5.21	5.14	0.003*	4.44	5.21	0.052
Maternal parity									
Mean	3.67	3.11	6.40	3.52	3.89		3.11	3.77	
Median	3.00	3.00	6.50	3.00	3.00		3.00	3.00	
Standard Deviation	2.23	1.60	2.54	2.24	2.30	<0.001*	1.60	2.31	0.004*
Number of living brothers									
Mean	1.00	0.66	2.20	1.06	1.01		0.66	1.07	
Median	1.00	0.00	2.00	1.00	1.00		0.00	1.00	
Standard Deviation	1.13	0.77	2.09	1.14	1.13	<0.001*	0.77	1.17	<0.001*
Socio-economic status score									
Mean	9.58	11.54	10.90	10.26	8.02		11.54	9.22	
Median	9.00	11.00	9.50	9.00	7.00		11.00	8.00	
Standard Deviation	5.25	4.52	4.77	5.37	4.56	<0.001	4.52	5.30	<0.001[d]

Data were missing for only one (0.2%) neonate for maternal age and socio-economic status score. *p<0.05,†p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

Table 21. (Continued) Demographic characteristics of the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by four and two caste groups

		Four Caste Categories					Two Caste Categories		
	All (N=464)	**Higher caste (N=71)**	**Other backward caste (N=10)**	**Backward class (N=199)**	**Scheduled caste (N=184)**	**p-value**	**Upper caste (N=71)**	**Lower caste (N=393)**	**p-value**
Maternal literacy									
Literate	156 (33.62%)	44 (61.97%)	0	78 (39.19%)	34 (18.47%)		44 (61.97%)	112 (28.49%)	
Somewhat literate	45 (9.69%)	11 (15.49%)	0	16 (8.04%)	18 (9.78%)		11 (15.49%)	34 (8.65%)	
Illiterate	263 (56.68%)	16 (22.53%)	10 (100%)	105 (52.76%)	132 (71.73%)	<0.001* <0.001*†	16 (22.53%)	247 (62.84%)	<0.001* <0.001*†

Data were missing for only one (0.2%) neonate for maternal age and socio-economic status score. *p<0.05,†p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

The Scheffe post-hoc test showed that the demographic characteristics of the OBC neonates were significantly different from the neonates of the other three caste groups with respect to maternal age, parity, and number of living brothers (Appendix K). Examination of adjusted residuals indicated that SC neonates had greater proportion of illiterate mothers compared to the neonates in other 3 caste groups (Appendix K). ANOVA test after excluding the OBC neonates from the analysis showed that the variation in maternal age among the three groups was statistically insignificant, p=0.224 (Appendix J). The Scheffe post-hoc test showed that number of living brothers among the higher caste neonates was significantly different from the neonates of the other two caste groups and the mean SES score was significantly lower among the scheduled caste neonates compared to the neonates of the other two caste groups (Appendix L). Examination of adjusted residuals indicated that SC neonates had greater proportion of illiterate mothers compared to the neonates in other 2 caste groups (Appendix L).

In summary, mothers of lower caste Hindu neonates had higher maternal age and parity, lower SES scores, and fewer of them were literate compared to the upper caste mothers. Lower caste neonates had at least one living brother whereas upper caste neonates did not have any living brother.

Neonatal Care and Neonatal Healthcare Services Utilization among Hindu Neonates

Neonatal care and neonatal healthcare services utilization in this study was measured through receipt of aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth), aseptic cord dressing (until cord fell off), any routine neonatal care, and treatment outside home for a life threatening complication experienced either on the first day

of birth or during 2-28 days. Receipt of neonatal care such as aseptic cord tie (7.1%), aseptic cord dressing-at the day of birth (11.4%), and aseptic cord dressing-until cord fell off (3.8%) as well as utilization of any routine NNC (1.9%) and treatment outside home (1.9%) was very low (Table 22). However, 74.3% neonates received aseptic cord cut. Overall, the utilization of neonatal care and neonatal healthcare services was negligible.

Neonatal Care and Neonatal Healthcare Services Utilization and Caste Affiliation

When the data were stratified by caste no difference was found between the two caste groups with respect to neonatal care and utilization of various neonatal healthcare services (Table 22). Similar proportion of upper and lower caste neonates received aseptic cord cut, aseptic cord tie, aseptic cord dressing-at the day of birth and until cord fell off, any routine NNC, and treatment outside home.

When data were analyzed for four caste groups we found that receipt of aseptic cord cut, aseptic cord dressing at the day of birth and until the cord fell off varied by caste affiliation, $p<0.05$ (Appendix M). Similar results were found when data were analyzed after excluding the OBC neonates from the analysis (Appendix N). Examination of adjusted residuals indicated that greater proportion of SC neonates received aseptic cord cut and greater proportion of OBC neonates received aseptic cord dressing at the day of birth and until it fell off compared to the neonates in other 3 caste groups (Appendix O). When OBC neonates were excluded from the analysis, greater proportion of lower caste neonates (SC and BC) were found to receive aseptic cord cut and aseptic cord dressing at the day of birth compared to the higher caste neonates (Appendix P).

In summary, there was no difference between the two caste groups with respect to the receipt of aseptic cord cut, aseptic cord tie, aseptic cord dressing-at the day of birth

Table 22. Neonatal care and neonatal healthcare services utilization among neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by two caste groups

	All (N=464)	**Upper caste (N=71)**	**Lower caste (N=393)**	**p-value**
Aseptic cord cut				
Yes	345 (74.35%)	51 (71.83%)	294 (74.80%)	
No	118 (25.43%)	20 (28.16%)	98 (24.93%)	
				0.573
Aseptic cord tie				
Yes	33 (7.11%)	7 (9.85%)	26 (6.61%)	
No	431 (92.88%)	64 (90.14%)	367 (93.38%)	
				0.328
Aseptic cord dressing (at the day of birth)				
Yes	53 (11.42%)	7 (9.85%)	46 (11.70%)	
No	410 (88.36%)	64 (90.14%)	346 (88.04%)	
				0.648
Aseptic cord dressing (until cord fell off)				
Yes	18 (3.87%)	3 (4.22%)	15 (3.81%)	
No	442 (95.25%)	68 (95.77%)	374 (95.16%)	
				0.748
Any routine neonatal care				
Yes	9 (1.93%)	1 (1.40%)	8 (2.03%)	
No	451 (97.19%)	70 (98.59%)	381 (96.94%)	
				1.000
Treatment outside home*				
Yes	9 (1.93%)	3 (4.22%)	6 (1.52%)	
No	455 (98.06%)	68 (95.77%)	387 (98.47%)	
				0.146

*For a life threatening complication experienced either on the first day of birth or during 2-28 days. Data were missing for 1 (0.2%) neonate for aseptic cord cut, 1 (0.2%) neonate for aseptic cord dressing-at the day of birth, for 4 (0.9%) neonates for aseptic cord dressing- until cord fell off, and 4 (0.9%) neonates for routine neonatal care utilization.

and until cord fell off, any routine NNC, and treatment outside home.

Neonatal Care and Neonatal Healthcare Services Utilization and Socio-demographic Factors

Hindu neonates whose cords were cut with aseptic instrument had a living brother compared to the neonates whose cords were cut with septic instrument, $p<0.10$ (Table 23). Mothers of neonates who received aseptic cord dressing (until cord fell off) had lower parity compared to the mothers of the neonates who did not receive aseptic cord dressing (until cord fell off), $p<0.10$ (Table 24). Mothers of the neonates for whom routine neonatal care was sought were younger, had lower parity, greater proportion of them were literate, and these neonates did not had a living brother compared to the neonates who did not receive routine neonatal care, $p<0.05$ (Table 25). Neonates who received treatment outside home did not had a living brother and they had higher SES score compared to the neonates who did not receive treatment outside home, $p<0.10$ (Table 25).

In summary, neonatal care and neonatal healthcare services utilization did not vary by caste affiliation. Neonates who received aseptic cord cut, routine NNC, and treatment outside home had fewer number of livings brothers than those who did not receive these healthcare services.

Multicollinearity Analysis for Socio-demographic Factors

Correlation between caste and SES was very weak ($r=0.20$, $p<0.01$) although positive and statistically significant, so was the correlation with maternal literacy ($r=0.29$, $p<0.01$) (Table 26). Maternal age and maternal parity were inversely correlated with caste; however, the correlation was statistically insignificant. Caste and number of living

Table 23. Demographic characteristics and receipt of aseptic cord cut and cord tie for the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

		Aseptic cord cut				Aseptic cord tie		
	All (N=464)	Yes (N=345)	No (N=118)	p-value	All (N=464)	Yes (N=33)	No (N=431)	p-value
Gender of the neonate								
Male	239 (51.50%)	185 (53.62%)	54 (45.76%)		239 (51.50%)	15 (45.45%)	224 (51.97%)	
Female	224 (48.27%)	160 (46.37%)	64 (54.23%)	0.140	225 (48.49%)	18 (54.54%)	207 (48.02%)	0.470
Maternal age (completed years)								
Mean	27.35	27.36	27.31		27.35	26.09	27.44	
Median	27.00	27.00	26.00		27.00	25.00	27.00	
Standard Deviation	5.12	5.07	5.28	0.917	5.09	5.36	5.09	0.169
Maternal parity								
Mean	3.67	3.70	3.56		3.67	3.67	3.67	
Median	3.00	3.00	3.00		3.00	3.00	3.00	
Standard Deviation	2.23	2.12	2.53	0.577	2.23	2.30	2.23	0.997
Number of living brothers								
Mean	1.00	1.06	0.85		1.00	0.85	1.02	
Median	1.00	1.00	1.00		1.00	0.00	1.00	
Standard Deviation	1.13	1.16	1.04	0.068	1.13	1.17	1.13	0.433
Socio-economic status score								
Mean	9.58	9.63	9.47		9.58	9.97	9.55	
Median	9.00	8.00	9.00		9.00	8.00	9.00	
Standard Deviation	5.25	5.52	4.42	0.753	5.25	6.75	5.13	0.727
Maternal literacy								
Literate	155 (33.40%)	110 (31.88%)	45 (38.13%)		156 (33.62%)	7 (21.21%)	149 (34.57%)	
Somewhat literate	45 (9.69%)	39 (11.30%)	6 (5.08%)		45 (9.69%)	4 (12.12%)	41 (9.51%)	
Illiterate	263 (56.68%)	196 (56.81%)	67 (56.77%)	0.104	263 (56.68%)	22 (66.66%)	241 (55.91%)	0.291
				0.523†				0.148†

Data were missing for 1 (0.2%) neonate for aseptic cord cut. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation

Table 24. Demographic characteristics and receipt of aseptic cord dressing (at the day of birth and until cord fell off) for the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Aseptic cord dressing-at the day of birth				Aseptic cord dressing-until cord fell off			
	All (N=464)	**Yes (N=53)**	**No (N=410)**	**p-value**	**All (N=464)**	**Yes (N=18)**	**No (N=442)**	**p-value**
Gender of the neonate								
Male	239 (51.50%)	28 (52.83%)	211 (51.46%)		238 (51.29%)	9 (50.00%)	229 (51.80%)	
Female	224 (48.27%)	25 (47.16%)	199 (48.53%)	0.851	222 (47.84%)	9 (50.00%)	213 (48.19%)	0.880
Maternal age (completed years)								
Mean	27.36	27.42	27.35		27.31	27.72	27.29	
Median	27.00	28.00	27.00		27.00	27.00	27.00	
Standard Deviation	5.11	4.48	5.19	0.928	5.10	5.50	5.08	0.749
Maternal parity								
Mean	3.67	3.51	3.69		3.66	2.72	3.69	
Median	3.00	3.00	3.00		3.00	2.00	3.00	
Standard Deviation	2.23	2.23	2.23	0.576	2.23	1.96	2.23	0.055
Number of living brothers								
Mean	1.01	1.06	1.00		1.00	0.67	1.01	
Median	1.00	1.00	1.00		1.00	0.00	1.00	
Standard Deviation	1.13	1.15	1.13	0.737	1.13	0.97	1.14	0.156
Socio-economic status score								
Mean	9.56	10.94	9.39		9.58	12.22	9.47	
Median	8.50	9.00	8.00		9.00	10.00	8.50	
Standard Deviation	5.25	6.84	4.99	0.114	5.26	8.83	5.05	0.207

Data were missing for 1 (0.2%) neonate for aseptic cord dressing-at the day of birth and for 4 (0.9%) neonates for aseptic cord dressing-until cord fell off. $^{*}p<0.05$, † p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

Table 24. (Continued) Demographic characteristics and receipt of aseptic cord dressing (at the day of birth and until cord fell off) for the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Aseptic cord dressing-at the day of birth				Aseptic cord dressing-until cord fell off			
	All (N=464)	**Yes (N=53)**	**No (N=410)**	**p-value**	**All (N=464)**	**Yes (N=18)**	**No (N=442)**	**p-value**
Maternal literacy								
Literate	156 (33.62%)	17 (32.07%)	139 (33.90%)		155 (33.40%)	6 (33.33%)	149 (33.71%)	
Somewhat literate	45 (9.69%)	6 (11.32%)	39 (9.51%)		45 (9.69%)	1 (5.55%)	44 (9.95%)	
Illiterate	262 (56.46%)	30 (56.60%)	232 (56.58%)	0.903 0.891†	260 (56.03%)	11 (61.11%)	249 (56.33%)	0.814 0.816†

Data were missing for 1 (0.2%) neonate for aseptic cord dressing-at the day of birth and for 4 (0.9%) neonates for aseptic cord dressing-until cord fell off. *$p<0.05$, † p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

Table 25. Demographic characteristics and utilization of routine neonatal care and treatment outside home sought by the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Routine neonatal care				Treatment outside home			
	All (N=464)	**Yes (N=9)**	**No (N=451)**	**p-value**	**All (N=464)**	**Yes (N=9)**	**No (N=455)**	**p-value**
Gender of the neonate								
Male	232 (50.00%)	5 (55.55%)	232 (51.44%)		239 (51.50%)	5 (55.55%)	234 (51.42%)	
Female	223 (48.06%)	4 (44.44%)	219 (48.55%)	1.000	225 (48.49%)	4 (44.44%)	221 (48.57%)	1.000
Maternal age (completed years)								
Mean	27.32	22.44	27.42		27.35	25.33	27.39	
Median	27.00	22.00	27.00		27.00	22.00	27.00	
Standard Deviation	5.09	2.00	5.08	<0.001*	5.11	5.56	5.10	0.303
Maternal parity								
Mean	3.66	1.56	3.71		3.67	3.22	3.68	
Median	3.00	1.00	3.00		3.00	2.00	3.00	
Standard Deviation	2.22	0.72	2.22		2.23	2.48	2.23	
				<0.001*				0.601
Number of living brothers								
Mean	1.00	0.11	1.02		1.00	0.56	1.01	
Median	1.00	0.00	1.00		1.03	0.00	1.00	
Standard Deviation	1.13	0.33	1.13	<0.001*	1.00	0.72	1.14	0.099
Socio-economic status score								
Mean	9.58	13.00	9.51		9.58	14.22	9.48	
Median	9.00	10.00	8.00		9.00	15.00	8.00	
Standard Deviation	5.26	11.41	5.06	0.387	5.25	4.52	5.23	0.014*
Maternal literacy								
Literate	156 (33.62%)	4 (44.44%)	152 (33.70%)		156 (33.62%)	4 (44.44%)	152 (33.40%)	
Somewhat literate	45 (9.69%)	3 (33.33%)	42 (9.31%)		45 (9.69%)	1 (11.11%)	44 (9.67%)	
Illiterate	259 (55.81%)	2 (22.22%)	257 (56.98%)	0.025*	263 (56.68%)	4 (44.44%)	259 (56.92%)	0.748
				0.144†				0.449†

Data were missing for 4 (0.9%) neonates for routine neonatal care. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

brothers were also inversely correlated (r=-0.11, p<0.05) but the correlation was weak. Caste was not strongly correlated with any socio-demographic factor.

Table 26. Correlation analyses of demographic characteristics of the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	1*	2*	3	4	5	6	7*
1. Caste*	1.0						
2. Gender of the neonate*	0.01	1.0					
3. Maternal age (completed years)	-0.07	0.02	1.0				
4. Maternal parity	-0.08	0.05	0.70‡	1.0			
5. Number of living brothers	-0.11†	-0.02	0.51‡	0.67‡	1.0		
6. Socio-economic status score	0.20‡	0.01	-0.04	-0.06	0.00	1.0	
7. Maternal literacy*	0.29‡	-0.01	-0.27‡	-0.30‡	-0.13‡	0.28‡	1.0

*Spearman's Rank Correlation. Pearson Correlation for maternal age, maternal parity, number of living brothers, and socio-economic status score. †p<0.05, ‡p<0.01. Data were missing for only one (0.2%) neonate.

Correlation between maternal age and maternal parity (r=0.70, p<0.01) was positive and strong but multicollinearity was not indicated (Table 26). The correlation between maternal age and number of living brothers (r=0.51, p<0.01) was positive and statistically significant but moderate. Similarly, maternal parity and number of living brothers were positively but moderately correlated (r=0.67, p<0.01).

Correlation between all socio-demographic variables was weak to moderate therefore multicollinearity was not indicated. No socio-demographic factor was strongly or moderately correlated with caste.

Multivariable Analyses and Neonatal Care and Healthcare Services Utilization

Aseptic Cord Cut

Upper caste neonates were as likely to receive aseptic cord cut as lower caste neonates (Table 27). We failed to reject the null hypothesis, H_{016}, and concluded that there was no difference between upper and lower caste neonates with respect to the receipt of aseptic cord cut.

Aseptic Cord Tie

Upper caste neonates were as likely to receive aseptic cord tie as lower caste neonates (Table 28). We failed to reject the null hypothesis, H_{017}, and concluded that there was no difference between upper and lower caste neonates with respect to the receipt of aseptic cord tie.

Aseptic Cord Dressing (at the day of birth)

Upper caste neonates were as likely to receive aseptic cord dressing (at the day of birth) as lower caste neonates (Table 29). We failed to reject the null hypothesis, H_{018}, and concluded that there was no difference between upper and lower caste neonates with respect to the receipt of aseptic cord dressing (at the day of birth).

Aseptic Cord Dressing (until cord fell off)

Upper caste neonates were as likely to receive aseptic cord dressing (until cord fell off) as lower caste neonates (Table 30). We failed to reject the null hypothesis, H_{019}, and concluded that there was no difference between upper and lower caste neonates with respect to the receipt of aseptic cord dressing (until cord fell off).

Routine NNC

Upper caste neonates were as likely to receive routine NNC as lower caste neonates (Table 31). We failed to reject the null hypothesis, H_{020}, and concluded that there was no difference between upper and lower caste neonates with respect to the receipt of

Table 27. Logistic regression analyses indicating receipt of aseptic cord cut by upper caste neonates compared to the lower caste neonates who were born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05) †		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00								
Upper caste	0.85	0.48, 1.49	0.573						
Gender of the neonate									
Female									
Male									
Maternal age (completed years)									
Maternal parity									
Number of living brothers	1.19	0.97, 1.45	0.083						
Socio-economic status score									
Maternal literacy									
Illiterate									
Somewhat literate									
Literate									

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Numbers in bold indicate statistical significance, p<0.05. Data were missing for 1 (0.2%) neonate.

Table 28. Logistic regression analyses indicating receipt of aseptic cord tie by upper caste neonates compared to the lower caste neonates who were born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05) †		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00								
Upper caste	1.54	0.64, 3.70	0.331						
Gender of the neonate									
Female									
Male									
Maternal age (completed years)									
Maternal parity									
Number of living brothers									
Socio-economic status score									
Maternal literacy									
Illiterate									
Somewhat literate									
Literate									

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Numbers in bold indicate statistical significance, p<0.05. Data were not missing for any neonate.

Table 29. Logistic regression analyses indicating receipt of aseptic cord dressing (at the day of birth) by upper caste neonates compared to the lower caste neonates who were born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			**Full Model (p<0.10)***			**Reduced Model (p<0.05) †**		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00								
Upper caste	0.82	0.35, 1.90	0.648						
Gender of the neonate									
Female									
Male									
Maternal age (completed years)									
Maternal parity									
Number of living brothers									
Socio-economic status score									
Maternal literacy									
Illiterate									
Somewhat literate									
Literate									

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Numbers in bold indicate statistical significance, p<0.05. Data were missing for 1 (0.2%) neonate.

Table 30. Logistic regression analyses indicating receipt of aseptic cord dressing (until cord fell off) by upper caste neonates compared to the lower caste neonates who were born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05) †		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00								
Upper caste	1.10	0.31, 3.90	0.883						
Gender of the neonate									
Female									
Male									
Maternal age (completed years)									
Maternal parity	0.77	0.58, 1.02	0.075						
Number of living brothers									
Socio-economic status score									
Maternal literacy									
Illiterate									
Somewhat literate									
Literate									

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Numbers in bold indicate statistical significance, p<0.05. Data were missing for 4 (0.9%) neonates.

Table 31. Logistic regression analyses indicating utilization of routine neonatal care by upper caste neonates compared to the lower caste neonates who were born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05) †		
	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Caste									
Lower caste	1.00								
Upper caste	0.68	0.08, 5.52	0.719						
Gender of the neonate									
Female									
Male									
Maternal age (completed years)	**0.76**	**0.63, 0.92**	**0.007**						
Maternal parity	**0.31**	**0.13, 0.73**	**0.007**						
Number of living brothers	**0.13**	**0.20, 0.95**	**0.045**						
Socio-economic status score									
Maternal literacy									
Illiterate	1.00								
Somewhat literate	**9.17**	**1.48, 56.57**	**0.017**						
Literate	3.38	0.61, 18.68	0.162						

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Numbers in bold indicate statistical significance, p<0.05. Data were missing for 4 (0.9%) neonates.

routine NNC. However, maternal age, maternal parity, number of living brothers, and maternal literacy were found to be significant determinants of utilization of routine NNC. The likelihood of utilization of routine NNC decreased with every unit increase in maternal age (ORc=0.76, 95% CI: 0.63, 0.92), maternal parity (ORc=0.31, 95% CI: 0.13, 0.73), and number of living brothers (ORc=0.13, 95% CI: 0.20, 0.95). Somewhat literate mothers were almost ten times more likely (ORc=9.17, 95% CI: 1.48, 0.01) to provide routine NNC to their neonates than illiterate mothers.

Treatment Outside Home

Upper caste neonates were as likely to receive treatment outside home as lower caste neonates (Table 32). We failed to reject the null hypothesis, H_{021}, and concluded that there was no difference between upper and lower caste neonates with respect to the receipt of treatment outside home. However, SES score was found to be significant determinant of utilization of treatment outside home. The likelihood of utilization of treatment outside home increased 11% (ORc=1.11, 95% CI: 1.02, 1.20) with every unit increase in SES score.

In summary, we found that almost all components of neonatal care and neonatal healthcare services were poorly utilized for the Hindu neonates of Maitha, UP, India. Neonatal care and utilization of neonatal healthcare services did not vary between upper caste and lower caste neonates. Socio-demographic factors such as maternal age, maternal parity, number of living brothers, SES score and maternal literacy were strong predictors of utilization of routine neonatal care and treatment outside home.

Table 32. Logistic regression analyses indicating treatment outside home for upper caste neonates compared to the lower caste neonates who were born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	Unadjusted Model			Full Model (p<0.10)*			Reduced Model (p<0.05)†		
	Crude OR	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**	**Adjusted OR**	**95% CI**	**p-value**
Caste									
Lower caste	1.00								
Upper caste	2.84	0.69, 11.65	0.146						
Gender of the neonate									
Female									
Male									
Maternal age (completed years)									
Maternal parity									
Number of living brothers	0.61	0.27, 1.38	0.238						
Socio-economic status score	**1.11**	**1.02, 1.20**	**0.011**						
Maternal literacy									
Illiterate									
Somewhat literate									
Literate									

OR: Odds Ratio. CI: Confidence Interval. *Adjusted for the variables that were significant at p<0.10 in the bivariate analysis. †Adjusted for the variables that were significant at p<0.05 in the full model. Numbers in bold indicate statistical significance, p<0.05. Data were not missing for any neonate.

DISCUSSION AND CONCLUSION

The goal of this study was to explore if caste was a determinant of maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization among Hindu women and neonates in Maitha, UP, India after adjusting for socio-demographic factors. We hypothesized that there was no difference between upper caste women/neonates and lower caste women/neonates with respect to the utilization of ANC, TT, IFA, trained birth attendant, PPC, contraceptives, treatment outside home (maternal), aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth and until cord fell off), routine NNC, and treatment outside home (neonatal). Data were analyzed for 482 Hindu women and 464 live born singleton Hindu neonates of Maitha, UP, India to test the study hypotheses.

In this chapter we first summarize and discuss our study results. Later we discuss the public health significance of our study which is followed by the suggestions for future research and intervention. Strengths as well as limitations of the study are presented later which leads to the conclusion of the dissertation.

Summary of Study Findings

Utilization of maternal healthcare services such as ANC, TT, IFA, trained birth attendant, PPC, contraceptives, and treatment outside home among Hindu women in Maitha, UP, India was very low. Utilization in this study population was lower than the national average[1] as well as the average for the rural population of UP, India,[21] other regions of India, and even Nepal.[10, 11, 22, 31, 34, 103, 104] In Maitha only 10.1% women utilized ANC which was lower than the average for rural UP (16.1%)[21], all UP(24.6%)[11], and much lower than all India average (65.1%).[1] ANC utilization in the southern states of Andhra Pradesh (88.4%),[10] Karnataka (85.3%),[10] Kerala (98.4%),[10] Tamil Nadu (94.7%),[10] and even Nepal (29.3%)[31] was higher than Maitha. TT utilization among the women of Maitha was relatively higher (49.3%) and comparable to rural UP (46.5%).[21] Yet, it was lower than all UP average (59.5%),[11] all India average (66.8%),[1] and southern states of Andhra Pradesh (75.5%),[10] Karnataka (70.6%),[10] Kerala (91.0%),[10] and Tamil Nadu (90.2%).[10] Relatively higher utilization of TT in this sample is also consistent with the national[1] and regional[21] health statistics. TT immunization has been available for free for over two decades through the National Immunization Program which explains the reason for higher utilization.[1] Only 14.9% women in Maitha ingested IFA which was much lower than rural UP (28.6%),[21] all UP (30.8%),[11] and all India average (57.6%).[1] Very few (3.7%) women in Maitha were attended by a trained professional at delivery which was comparable to women in rural UP (3.6%)[21] but lower than all UP average (12%).[131] Larger proportion of women in India (42.3%)[1] and in south Indian states of Andhra Pradesh (60.7%),[10] Karnataka (57.4%),[10] Kerala (92.7%),[10] Tamil Nadu (77.3%),[10] and rural Karnataka (59%)[103] are attended by trained professionals at delivery

than the women in Maitha. PPC was barely (1.0%) utilized by women in Maitha and it was not even comparable to the all India average (16.5%).[1] Only 8.0% women in Maitha used contraceptives. Contraceptive utilization was very low when compared to rural UP (18.3%),[21] all India average (42.8%),[1] and even rural Nepal (37%).[34] Only 6.4% women in Maitha sought treatment outside home for a complication experienced either during pregnancy, childbirth, or postpartum. This indicator could not be compared with the rest of the country since data were not available, however, one study reports that approximately 40% women from UP had sought advice for pregnancy or post-pregnancy complications.[104]

Utilization of ANC, TT, trained birth attendant, and contraceptives was poorer among lower caste women compared to the upper caste Hindu women of Maitha, UP, India. These study results were consistent with those from studies from India and Nepal.[6, 10, 11, 22, 31, 34, 102, 103] Studies from different parts of India showed that ANC utilization varied by caste affiliation. In Andhra Pradesh SC or lower caste women were almost 30% less likely ($p<0.05$) to receive ANC compared to the non-SC women.[10] In Karnataka, SC or lower caste women were 40% less likely ($p<0.01$) to receive ANC in first trimester compared to non-SC women.[10] In rural Karnataka ANC utilization in first trimester significantly varied by caste affiliation ($p<0.01$),[22] another study from Karnataka showed that fewer number of SC women received good quality ANC.[102] Similarly, in Nepal level of ANC utilization varied by caste affiliation ($p<0.01$).[31] Similar to our study findings, other researchers have also reported that presence of trained attendant at delivery varied by caste affiliation. A recent study from UP showed that upper caste women were more likely to be assisted by trained professional at birth (OR=1.22, $p<0.10$) and to deliver at

hospital (OR=1.70, p<0.05) compared to SC or scheduled tribe i.e., the lower caste women.[104] In Karnataka, Kerala, and Tamil Nadu, SC or lower caste women were less likely (OR=0.52, p<0.01, OR=0.36, p<0.05, and OR=0.73, p<0.10, respectively) to be attended by a health professional during delivery compared to non-SC women.[10] In rural Karnataka, SC or scheduled tribe i.e., the lower caste women were 0.29 times less likely to intend to deliver at home with ANMs assistance than Gowda or upper caste women (p<0.05).[103] In Maitha upper caste women were 2.5 times more likely (p<0.01) to receive TT shots than lower caste women. This study result was inconsistent with the results of the study from northern India where other caste women were 0.7 times less likely (p<0.05) to receive TT than SC or lower caste women[11] and results form a study from southern India where TT utilization did not vary by caste affiliation.[10] This inconsistency could be due to the fact that we had used TT utilization data not only for current pregnancy but also for the previous pregnancy. Consistent with our findings, contraceptive utilization has been reported to vary by caste affiliation by other researchers in India and Nepal. In rural Bihar, India SC or lower caste women were almost 50% less likely to use female sterilization than upper caste women (p<0.05).[6] Studies from Nepal[34, 35] showed that contraceptive utilization varied by caste affiliation.

Besides caste, high SES score, fewer number of living sons, and maternal literacy were positively associated with the utilization of maternal healthcare services such as ANC, TT, trained birth attendant, and contraceptives. Other researchers[10, 11, 22, 31, 102, 103] have also found that these socio-demographic factors influence utilization of MCH services. In UP, women who had higher standard of living were 1.2 times (p<0.01) more likely to receive ANC than women who had lower standard of living.[11] Another study

from UP[106] showed similar results. In Karnataka and Kerala women who had higher or medium standard of living were more likely to receive ANC than women who had lower standard of living ($p<0.05$).[10] Similarly, women who had medium standard of living in Karnataka and Tamil Nadu were more likely to receive TT than women who had lower standard of living ($p<0.05$).[10] In UP high and medium SES women were almost twice as likely to be attended by trained personnel as were lower SES women ($p<0.10$).[99, 104] In Andhra Pradesh, Tamil Nadu, and Karnataka women who had higher standard of living were almost four times more likely to be attended by a health professional at birth compared to women who had lower standard of living ($p<0.01$).[10] Similar results were found for women in Kerala[10] and rural Karnataka.[103] SES was significantly and positively associated with contraceptive utilization in UP.[6, 18, 106] There were no studies available to compare the results of the association that we observed between number of living sons and ANC utilization, TT receipt, and presence of trained birth attendant with other studies. But there were studies from UP,[18] rural Bihar,[6] and West Bengal, [9] India as well as from Nepal[5, 32, 36] and Bangladesh[107, 108] that showed that contraceptive utilization increased exponentially with every unit increase in number of living sons.

In summary, maternal healthcare services utilization did vary by caste affiliation even after adjusting for socio-demographic factors. We rejected null hypotheses H_{01}, H_{02}, H_{04}, H_{06}, H_{08}, H_{09}, and H_{011}. Upper caste women were 2.5 times more likely to utilize TT compared to the lower caste women; post-hoc power analysis showed that our study results had a power of 93%. For other components of maternal healthcare services the type II error was higher than 20%.

Like maternal healthcare services utilization, neonatal care as well as neonatal healthcare services utilization among the live-born singleton Hindu neonates in Maitha, UP, India was also low. Receipt of neonatal care such as aseptic cord cut, aseptic cord tie, aseptic cord dressing (at the day of birth), and aseptic cord dressing (until cord fell off) as well as healthcare services such as routine NNC and treatment outside home was very low in this study sample. There are no national or state level data available to compare neonatal care and healthcare services utilization levels that we found in Maitha. Researchers in India and neighboring countries either focus on determinants of neonatal morbidities and mortalities or on child healthcare. Determinants of neonatal care and healthcare services utilization are not researched.

Neonatal care and neonatal healthcare services utilization in Maitha did not vary by caste affiliation. Receipt of neonatal care and utilization of neonatal healthcare services by lower and upper caste neonates was similar. We did not find any association between caste and neonatal care as well as neonatal healthcare services utilization. Although two studies demonstrated an association between caste and umbilical cord infection[48] and child healthcare needs,[109] no neonatal health studies were available to compare the results of neonatal care and neonatal healthcare services utilization.

Socio-demographic factors such as maternal age, maternal parity, number of living brothers, SES score, and maternal literacy were strong predictors of utilization of routine neonatal care and treatment outside home. A study from Bangladesh showed that families with higher income were more than twice as likely to seek care for their newborns compared to families with lower income.[110] Other studies from India showed that children from families that had higher SES score were more likely to receive care or

treatment outside home than children from families that had lower SES scores.[56, 64, 109] Surprisingly, the gender of the neonate, a very strong predictor of child healthcare in India and South East Asia, did not influence neonatal care and neonatal healthcare services utilization in this sample. Probably, we failed to notice any association between gender and neonatal care and utilization of neonatal healthcare services due to overall low receipt of aseptic umbilical cord care and low utilization of neonatal healthcare services in our study sample. The association that we observed was comparable to a neonatal study from Nepal which showed that female neonates were as likely to get umbilical cord infection as male neonates[48] and another study from Bangladesh that showed that gender of the neonate had insignificant association with neonatal morbidity.[110] Yet, this interpretation needs to be considered with caution because it deals with neonatal morbidity and mortality and not with neonatal care and neonatal healthcare services utilization. Other studies from India and Bangladesh showed that male children[56, 64, 65, 70, 109, 111] or neonates[110] were more likely to receive healthcare services than female children or neonates. There were no studies from India to compare the results of the association between gender and neonatal care and neonatal healthcare services utilization. Due to paucity of research on neonatal care and neonatal healthcare services utilization it is difficult to explain the counterintuitive findings. We speculate that probably umbilical cord care, routine care, and treatment outside home for the neonates are not significantly associated with the gender of the neonate.

Receipt of neonatal care and utilization of neonatal healthcare services in our study sample was almost negligible making it difficult to identify statistically significant differences between the two caste groups. Low utilization hindered hypothesis testing

which was dependant upon quantitative data and statistical significance. We found no statistically significant associations between caste and neonatal care and neonatal healthcare services utilization. We failed to reject null hypotheses H_{016}-H_{027}. Post-hoc power analysis showed that our study results had less than 80% power indicating that the likelihood of committing the error of rejecting the false null hypothesis was unacceptably high. A bigger sample and higher utilization was required for more power, in such an instance study results should be examined with caution.

In conclusion, utilization of maternal healthcare services and neonatal care as well as neonatal healthcare services was very low. Upper caste women were more likely to utilize most of the maternal healthcare services when compared to the lower caste women. These findings were consistent with other studies from India and the Indian subcontinent. On the other hand, upper caste neonates were as likely to receive neonatal care and as likely to utilize neonatal healthcare services as lower caste neonates but these results could not be compared to other studies. Perhaps we can compare the results of maternal healthcare services utilization with neonatal healthcare services utilization but it would be inappropriate to compare the results of umbilical cord care with maternal healthcare services utilization. The reason being that the components of maternal healthcare services such as ANC, TT, IFA, etc. reflect utilization of actual services which are available at the primary health centers or through the healthcare workers but umbilical cord care does not reflect healthcare service utilization of similar character. We acknowledge that there was an inconsistency between our study findings for maternal healthcare services utilization and neonatal healthcare services utilization. Caste was a significant determinant of maternal healthcare services utilization such as ANC but not of neonatal

healthcare services utilization such as NNC. Probably, we failed to notice statistically significant association between caste and neonatal healthcare services utilization because the utilization of NNC for neonates was much lower than the utilization of ANC for mothers. We had only two components of neonatal healthcare services utilization, both of which were sparingly utilized, in such instance it is difficult to comment any further.

Public Health Significance of the Study

Results of this study demonstrate that the healthcare needs of women and especially that of neonates in rural northern India have long been overlooked. Despite the availability of healthcare services at subsidized prices in rural India the utilization is almost negligible. Unless the utilization is optimized the status of maternal and neonatal health can not be improved. It is known that optimum utilization of MCH services is a key to reduce maternal and child morbidity and mortality[10] and that there is an urgent need to focus on women's healthcare services utilization in rural India.[43] Based on the findings of this study we suggest that, foremost, the Ministry of Health and Family Welfare, India and the state Health and Family Welfare Department in UP should improve its outreach to improve utilization of healthcare services in less developed regions of the country such as UP. Amendments in the National Population Policy based on scientific and systematic inquiry are necessary and imminent. Although, several studies were conducted to identify and understand why maternal healthcare services are underutilized in developing countries including rural India,[40, 43, 113, 132-138] there is a paucity of research for rural communities of UP. In a vast and diverse country like India, country-wide generalizations are unwarranted and more local assessments are necessary to develop accurate

and reliable explanations of healthcare-seeking behavior.[43] Navaneetham et al., comments that there is no universal explanation that applies to all socioeconomic and cultural contexts.[10] Furthermore, Pallikadavath et al., assert that socio-cultural factors are likely to be critical determinants of health service utilization.[11] Regional variations in India emphasize a need for population-based studies to explore the barriers to utilization of maternal and neonatal healthcare services. Health policy makers in India have acknowledged a gap in the in-depth analyses of maternal and neonatal healthcare inequalities and caste disparities.[16] This study acknowledged the above stated need to identify and explore the barriers to poor utilization of maternal and neonatal healthcare services in a rural region of the country. Our literature search indicated that a few researchers had found an association between caste and healthcare services utilization but there were no studies from rural northern India that had done an in-depth analysis. Based on the findings of the literature review and prior empirical knowledge that caste in rural UP is a significant determinant of utilization of public services such as health, this study was necessary and timely.

In this study we addressed these issues by examining if caste was a barrier to healthcare services utilization among the rural women and neonates of Maitha, UP, India. This study simultaneously explored other potential barriers such as SES, gender of the neonate, maternal literacy etc., to healthcare services utilization. Study results indicated caste disparities in maternal and neonatal healthcare services utilization. We also identified several opportunities for improving utilization and minimizing caste disparities among the mothers and neonates of Maitha, UP, India. This study not only fills the re-

search gaps and contributes to the scientific knowledge it also provides cues for action to optimize healthcare services utilization and strategies to reduce caste disparities.

Rural UP in India is one of the least developed regions of the country and has exceptionally poor MCH indicators. Public health interventions informed by scientific research are urgently required to make a positive impact on the health of mothers and children in this region. The Ministry of Health and Family Welfare, Govt. of India, provides care to mothers and newborns through the National Family Welfare program and the Reproductive and Child Health program. The State Health Department receives assistance from the Ministry of Health to cater to the specific maternal and child healthcare needs of its target population. The Govt. of India not only provides the structure for delivery of services but it also secures assistance from non-governmental organizations and international donors to address the urgent healthcare needs of women and children. Despite these efforts the goals have not been achieved. So far most of the resources and efforts have been directed towards population control and a need for optimum health of women and children have been overlooked. Scientific research is required to inform the policy makers about the healthcare needs of women and children. We need to advocate for policy and program modifications so that we can improve the utilization of services and eventually promote better health for women and children. In absence of optimum and equal utilization of available healthcare services the goal of achieving health for all will go in vain.

Healthcare interventions informed and guided by scientific public health research can systematically and strategically address the barriers to low utilization of maternal and neonatal healthcare services. The status of maternal and neonatal health in rural India is

poor not due to the lack of services but due to the reluctance of the consumers to utilize the services. Factors such as caste, lack of knowledge, or attitude of the consumers towards the services or healthcare providers seem to play a crucial role. Public health research specific to the population group and the health issue is urgently required to overcome barriers to healthcare utilization and to eventually promote maternal and child health.

Suggestions for Future Research and Intervention

This study demonstrated a need for population-based quantitative research in Maitha to explore whether caste is also a barrier to the availability, accessibility, and receipt of other MCH services such as immunization, hospitalization, infectious diseases management, etc. Qualitative research is also required to identify and explore if caste is a barrier at consumer's-end or provider's-end. Qualitative methods such as focus group discussions and in-depth interviews can help us explore the inhibitions of the healthcare providers and consumers in the context of caste. Pallikadavath et al., (2004) comment that it is possible that health workers are more reluctant to visit the homes of lower caste women and conversely, some upper caste women may prefer not to invite health workers in their home perhaps for reasons of caste.[11] Such speculations need systematic scientific enquiry. It would be useful to collect socio-demographic data such as caste affiliation, gender, age, years of experience, etc. for the healthcare providers. Data indicating the attitudes and biases of the providers and consumers with respect to caste will be helpful.

We found that caste was a significant predictor of presence of a trained attendant at delivery. Almost all women (95%) in Maitha were attended by traditional birth atten-

dants, *Dai* or *Dhankun*, who belong to the lower caste groups because traditionally, birth assistance has been considered a menial job, fit for lower caste women. Traditional birth attendant classification in Maitha is more complicated than it is in the other parts of the country. Although both *Dai* and *Dhankun* belong to lower caste groups in Maitha but the later belongs to the lowest caste group. Moreover, their roles during delivery assistance are also exclusive. *Dai* has skills in attending child birth and *Dhankun* on the other hand specializes in umbilical cord-care. In absence of a trained professional, presence of both will be ideal. Monetary compensation could be a barrier for the lower caste women to have both the providers. Very few women were attended by trained birth attendants such as doctors or ANMs. The caste status of the trained birth attendants is not known but we speculate that doctors or ANMs will most likely belong to upper caste because upper caste people are more likely to attend medical or nursing schools. Due to traditional beliefs in untouchability and physical distancing that are explained earlier, we further speculate that upper caste doctors or ANMs will be reluctant to attend lower caste women during delivery. This may explain why almost all women, irrespective of caste affiliation, were attended by traditional birth attendants. Due to financial constraints probably smaller number of lower caste neonates received aseptic cord care from *Dhankun* who specializes in umbilical cord-care. It would be erroneous to come to these conclusions in absence of further scientific research. However, this indicates an urgent need to train the traditional birth attendants in child birth as well as maternal and neonatal post partum care since they are widely accepted by women of both caste groups.

Among rural women child birth is considered to be an uncomplicated natural reproductive event not worthy of professional assistance but assistance is usually sought for

abortion. It will be interesting to know how caste affiliation influences abortion care among rural women. At the same time it is essential to examine if caste is a barrier to the utilization of infant and child (2-5years old) healthcare services as it has been indicated by a few researchers in previous studies. Since caste societies in India have a hierarchal structure, it is necessary to explore a linear association between caste groups and health-care services utilization. Such dynamics of caste and healthcare services utilization could not be explored in this study. Studies from other parts of India have superficially examined the association between caste and maternal and child health. This research gap needs to be filled so that we can identify strategies to overcome barriers to optimum maternal and child health.

Because funding for social healthcare research in India is limited it will be difficult to secure money for population-based studies. However, researchers can utilize the data from the NFHS and undertake ecological analyses. Data from urban hospitals can also be used to study not only caste specific healthcare services utilization but also morbidity and mortality patterns. Caste and maternal and child health is a new area of scientific enquiry, there are innumerable research questions and hypotheses that need to be tested to better inform our healthcare intervention strategies.

This study demonstrated that to improve the health of mother and newborns in Maitha, first and foremost the utilization of available healthcare services must improve. Approaches to improving healthcare services utilization include extending the coverage of services, promoting uptake of services among all population groups, and minimizing unequal and low coverage.[17] Researchers should also network with the health policy makers in India to review the maternal and child health programs, public health policy,

and India's National Population Policy to determine other measures that can be taken to promote equal utilization of services among all caste groups.

We found that caste was a significant deterrent to maternal healthcare services utilization. Policy makers in India are aware of the fact that caste is a barrier to social mobility. This concern has been addressed by introducing the policy of affirmative action where lower caste groups are offered equal opportunities for education and employment. Health Departments at the state and district level should implement this policy by recruiting more healthcare workers from the lower caste groups. Especially the outreach workers such as ANMs, Village Health Guides, Female Health Workers, and Multi Purpose Workers who reach out to women and children in the communities need to be from the lower caste groups. Lower caste women will probably be more comfortable and less threatened to receive services from a healthcare provider of similar caste group. Healthcare utilization by upper caste women is higher despite the fact that most of the traditional healthcare workers (*Dai* and *Dhankun*) are from lower caste. Thus, if the trained healthcare providers are from lower caste groups that should not inhibit the utilization among the upper caste women. On the contrary, it should encourage utilization among all caste groups. Studies from the US have shown that the utilization of healthcare services increases if the healthcare provider is the same race as the client/patient.[139-144] Program planners and policy makers in India can utilize this knowledge to overcome social barriers such as caste and improve healthcare services utilization among women and children in India.

There is also a need to promote a holistic approach to healthcare delivery by the health workers. Relatively higher utilization of TT and aseptic blade (for cutting the um-

bilical cord) indicate that the healthcare workers who provide TT and aseptic blade or safe delivery kit can be approached to promote the use of similar maternal and neonatal healthcare services. The healthcare workers need to understand the relevance of the continuum of maternal and child healthcare. They should be able to address the healthcare needs from conception until postpartum by either providing the services themselves or by facilitating referrals or through networking.

We found that maternal literacy was a significant determinant of healthcare services utilization. Literate mothers were more likely to utilize healthcare services than somewhat literate or illiterate mothers. Maternal literacy positively influenced utilization, and could provide a mechanism to improve utilization of maternal and neonatal healthcare services in both the lower and upper castes. Dissemination of information and generating awareness about the availability of the subsidized healthcare services at the government-run health facilities will optimize the utilization among women who are illiterate. Older mothers and those with the desired number of living sons were more reluctant to utilize healthcare services. So were the lower caste and poor mothers. Healthcare professionals need to identify these women in the community and design strategies to reach them. Above all, there is a need to proactively monitor healthcare services utilization and caste disparities in our communities. Program planners can set realistic targets to improve utilization and encourage lower caste women to use the available services.

Strengths and Limitations

This study from Maitha, UP, India provides in-depth information about the level of utilization of maternal as well as neonatal healthcare services. No previous studies or

databases with such information are available. This is one contribution of this study to the knowledge base of public health research and intervention.

Furthermore, this study to our knowledge is the first one to explore the association between caste and maternal healthcare services utilization and neonatal care as well as neonatal healthcare services utilization after adjusting for other socio-demographic factors. The study does not address the healthcare issues of women and neonates in isolation but it examines those issues in a relevant social context. We acknowledged the fact that caste, a socio-demographic factor, is a prime determinant of health in the given study population. For this reason, the study was primarily designed to examine the association between caste and utilization of maternal and neonatal healthcare services. Other factors were examined subsequently. This study adequately addressed the socio-demographic factors in healthcare services utilization and has contributed to the knowledge base of social science research. Results of this study indicate various social factors that hinder healthcare services utilization. There are very few studies available that have explored the association between number of living sons/brothers and utilization of maternal and neonatal healthcare services especially for a study population that is patriarchal and where sons are preferred over daughters. Furthermore, factors influencing utilization of neonatal healthcare services have been sparingly researched in India; this study is the only one to explore barriers to neonatal care. Barriers to other components of MCH such as PPC and treatment outside home are also not known from previous research, this study addressed such under-researched components.

Data for this study were derived from a recent population-based study, the sample of which was diverse in caste composition and it adequately represented the target popu-

lation. There are very few studies from northern India that address the health of rural women and neonates. This study provided information about the status of maternal and neonatal health for a rural population. The cross-sectional study design was appropriate since our primary interest was to examine an association between the independent variable, caste, and dependent variables, maternal and neonatal healthcare services utilization. The results of this study are generalizable to other Hindu women and neonates living in Maitha block. The results can also be generalized to women who deliver at home and the newborns that are born at home in rural northern India.

A major limitation of this study was the secondary data analyses of the MAP study. The sample and the structure of the data were fixed. Primary data collection gives an opportunity to suitably define study variables and collect in-depth information on other components of neonatal care such as BCG vaccine. We used crude measures of maternal and neonatal healthcare which lacked information on other important features, e.g., components of ANC care such as physical examination, blood pressure measurement, weight-height measurement, etc. We also did not have any information about the caste affiliation of healthcare providers. Socio-demographic characteristics of the providers were not known. Of all the healthcare providers in the community we only knew the caste status of the *Dai* and *Dhankun* this information was insufficient. Such comprehensive information was not available in the MAP data set. In the absence of such information we had to restrict the scope of our study. It would have been interesting to study the same hypothesis after supplementing the information about socio-demographic characteristics of the provider. We had insufficient information about the cultural, anthropological, and sociological framework of our study population.

MAP data were collected retrospectively through personal interviews. This increased the possibility of under reporting due to information bias, telescoping, and recall bias. These limitations were acknowledged and addressed repeatedly. The mean recall period was only 14.3 ± 3.7 months (range 8-26 months).[121] Moreover, the MAP questionnaire structure and design (described above) minimized the possibility of errors in recall and reporting. Concerns regarding information bias were adequately addressed during the study and questionnaire design phase, training of the interviewers, data collection phase, quality control, and the preliminary data analysis phase. Interviews were conducted in the local language by the community health workers who were not only familiar with the women of the community but were also well versed in maternal and child health issues. Data quality measures included re-visits to 2% of the households to verify the information.[121] Interviews were not only available in the structured questionnaires but they were also audiotaped. Each questionnaire/interview was reviewed against the audiotaped responses for internal consistency.[121] Double data entry and preliminary analyses were helpful to resolve data entry errors.

The results for TT utilization need cautious interpretation. Since the utilization was very low the statistical analysis was becoming difficult. To overcome this problem data on TT receipt during the current pregnancy as well as the previous pregnancy were used. This slightly inflated the proportion of women who received TT and biased the results.

In the given socio-cultural context caste had a four level hierarchy, the dichotomization of caste variable was probably not the best choice, but due to the low utilization of services and the fact that only 10% women belonged to the OBC group, the caste catego-

ries were dichotomized. With a bigger sample size and higher utilization rate the study results would have achieved power of 80% or more.

Despite these limitations, this study has made a significant contribution to the social science research and public health knowledge base. The study shows that there is an urgent need to improve healthcare services utilization in rural India and caste as a barrier to utilization needs to be overcome.

Conclusions

Caste among Hindus in India is a barrier to not only socio-economic elevation but also to healthcare services that are crucial for optimum growth and development. Status of maternal and child health in rural northern India is very poor and in severe need of improvement. Despite the availability of subsidized MCH services in India the utilization is bare minimum. Reasons for poor utilization are sparingly researched in India. In absence of scientific enquiry it is difficult to address the barriers and design strategies to improve utilization.

This study examined whether caste influenced the healthcare services utilization. We found that healthcare services utilization was not only low but it also varied by caste affiliation. Health of women and neonates can be improved by optimizing the utilization of available healthcare services among all caste groups. Besides caste, other socio-demographic factors that hindered healthcare services utilization were also examined.

At the same time we identified mechanisms to overcome these barriers and improve utilization. Utilization can be improved by giving opportunities to people of lower

caste groups to join the healthcare workforce. Utilizing the knowledge from the racial healthcare disparities research in the US, it is suggested that the concept of 'consumer-provider caste concordance' similar to 'patient-physician racial concordance'[144] be applied to overcome caste disparities in health in India. Unarguably, utilization can certainly be improved among all caste groups through information dissemination and awareness generation. Illiterate mothers need to be made aware of the available healthcare services and the benefits of using these services. Last but not the least the policy makers and program planners in India need to modify their programs and strategies to ensure that the utilization is optimum and equal across all caste groups.

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APPENDIX A

Description of assigned weights and scores for the household assets to create the Socio-Economic Status Index

Questions	Response Options	Assigned Weights	Assigned Scores
Q. 115: Where do you go OR what do you use for toilet?	• Bush or Field • Pit toilet or Latrine • Other	1 2 0	Score = Weight
Q. 116: What is the material or the floor (in main room) of your house?	• Kuchha (earth or dung) • Semi-pucca (brick or sand) • Pucca (cement) • Other	1 2 3 0	Score = Weight
Q. 117: Does your household have…?	• Electricity • Radio • Television • Kerosene or gas stove • Sewing machine • Generator	1 1 2 1 1 2	Score = Weight
Q. 118: How much agricultural land does your household own, if any?	• Landless (No land) • Marginal (Up to 1 acre) • Small (>1-2.5 acre) • Medium (>2.5-10 acre) • Large (>10 acre)	0 1 2 3 4	Score = Weight
Q. 119: How many animals does your household keep for economic reasons, if any?	• Cow • Buffalo • Bull • Goat • Pig • Poultry • Snake	2 2 2 1 1 1 1	Score = (Weight)*(Number)
Q. 120: Does anyone in your household own a mode of transport such as…?	• Bicycle • Bullock / cart • Horse / cart • Motor cycle/ scooter • Tractor trolley • Tempo	1 1 1 2 3 3	Score = Weight

APPENDIX B

IRB Approval Form

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Institutional Review Board for Human Use

Form 4: IRB Approval Form
Identification and Certification of Research
Projects Involving Human Subjects

UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56 and ICH GCP Guidelines. The Assurance became effective on November 24, 2003 and expires on February 14, 2009. The Assurance number is FWA00005960.

Principal Investigator:	SAROHA, EKTA
Co-Investigator(s):	
Protocol Number:	**E060411001**
Protocol Title:	*Caste as a Determinant of Utilization of Maternal and Neonatal Health Care Services in Maitha, Uttar Pradesh, India*

The above project was reviewed on 5/19/06. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This project qualifies as an exemption as defined in 45CF46.101, paragraph 4.

This project received EXEMPT review.

IRB Approval Date: 5/19/06

Date IRB Approval Issued: 05/19/06

Sheila Moore, CIP

Sheila Moore, CIP
Director, Office of the Institutional
Review Board for Human Use (IRB)

Investigators please note:

IRB approval is given for one year unless otherwise noted. For projects subject to annual review research activities may not continue past the one year anniversary of the IRB approval date.

Any modifications in the study methodology, protocol and/or consent form must be submitted for review and approval to the IRB prior to implementation.

Adverse Events and/or unanticipated risks to subjects or others at UAB or other participating institutions must be reported promptly to the IRB.

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APPENDIX C

Demographic characteristics of the women from three caste groups who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=472)	**Higher caste (N=75)**	**Backward class (N=209)**	**Scheduled caste (N=188)**	**p-value**
Maternal age (completed years)					
Mean	27.24	26.52	27.19	27.57	
Median	27.00	26.00	27.00	27.00	
Standard Deviation	5.10	4.49	5.26	5.15	0.315
Maternal parity					
Mean	3.63	3.15	3.56	3.88	
Median	3.00	3.00	3.00	3.00	
Standard Deviation	2.18	1.60	2.24	2.29	0.041*
Number of living sons					
Mean	0.96	0.67	1.02	1.01	
Median	1.00	0.00	1.00	1.00	
Standard Deviation	1.09	0.77	1.13	1.13	0.039*
Socio-economic status score					
Mean	9.60	11.81	10.19	8.06	
Median	8.00	11.00	9.00	7.00	
Standard Deviation	5.33	4.77	5.79	4.53	<0.001*
Maternal literacy					
Literate	162 (34.32%)	47 (62.66%)	80 (38.27%)	35 (18.61%)	
Somewhat literate	48 (10.16%)	11 (14.66%)	19 (9.09%)	18 (9.57%)	
Illiterate	262 (55.50%)	17 (22.66%)	110 (52.63%)	135 (71.80%)	<0.001*
					<0.001†

Data missing for only one (0.2%) woman for maternal age and socio-economic status score. *p<0.05, †p-value for Mantel-Haenszel trend test for linear association of maternal literacy with caste affiliation.

APPENDIX D

Scheffe post-hoc analysis and examination of adjusted residuals indicating the caste group with outstanding demographic characteristics for the women from four caste groups who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=482)	**Higher caste (N=75)**	**Other backward caste (N=10)**	**Backward class (N=209)**	**Scheduled caste (N=188)**	**Subset A**	**Subset B**
Mean maternal age (completed years)	27.35	26.52	32.70	27.19	27.57	Higher caste, Backward class, Scheduled caste, **p=0.874**	Other backward caste, **p=1.000**
Mean maternal parity	3.68	3.15	6.40	3.56	3.88	Higher caste, Backward class, Scheduled caste, **p=0.606**	Other backward caste, **p=1.000**
Mean number of living sons	0.99	0.67	2.20	1.02	1.01	Higher caste, Backward class, Scheduled caste, **p=0.644**	Other backward caste, **p=1.000**
Mean socio-economic status score	9.62	11.81	10.90	10.19	8.06	Other backward caste, Backward class, Scheduled caste, p=0.180	Other backward caste, Backward class, Higher caste, p=0.658
Maternal literacy							
Literate	162 (33.60%)	47 (62.66%)	0	80 (38.27%)	35 (18.61%)	N/A	N/A
Adjusted residuals		**5.8**	-2.3	1.9	-5.6		
Somewhat literate	48 (9.95%)	11 (14.66%)	0	19 (9.09%)	18 (9.57%)	N/A	N/A
Adjusted residuals		1.5	-1.1	-0.6	-0.2		
Illiterate	272 (56.43%)	17 (22.66%)	10 (100%)	110 (52.63%)	135 (71.80%)	N/A	N/A
Adjusted residuals		-6.4	2.8	-1.5	**5.4**		

Subset for alpha=0.05. Numbers in bold (high p-value and adjusted residuals) indicate statistical significance

APPENDIX E

Scheffe post-hoc analysis and examination of adjusted residuals indicating the caste group with outstanding demographic characteristics for the women from three caste groups who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=472)	**Higher caste (N=75)**	**Backward class (N=209)**	**Scheduled caste (N=188)**	**Subset A**	**Subset B**
Mean maternal age (completed years)	27.24	26.52	27.19	27.57	Higher caste, Backward class, Scheduled caste, p=0.256	None
Mean maternal parity	3.63	3.15	3.56	3.88	Higher caste, Backward class, p=0.308	Backward class, Scheduled caste, p=0.504
Mean number of living sons	0.96	0.67	1.02	1.01	Higher caste, **p=1.000**	Backward class, Scheduled caste, **p=0.991**
Mean socio-economic status score	9.60	11.81	10.19	8.06	Higher caste, Backward class, Scheduled caste, p=1.000	None
Maternal literacy						
Literate	162 (34.32%)	47 (62.66%)	80 (38.27%)	35 (18.61%)	N/A	N/A
Adjusted residuals		**5.6**	1.6	-5.8		
Somewhat literate	48 (10.16%)	11 (14.66%)	19 (9.09%)	18 (9.57%)	N/A	N/A
Adjusted residuals		1.4	-0.7	-0.3		
Illiterate	262 (55.50%)	17 (22.66%)	110 (52.63%)	135 (71.80%)	N/A	N/A
Adjusted residuals		-6.2	-1.1	**5.8**		

Subset for alpha=0.05. Numbers in bold (high p-value and adjusted residuals) indicate statistical significance

APPENDIX F

Maternal healthcare services utilization by four caste groups for the women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=482)	Higher caste (N=75)	Other backward caste (N=10)	Backward class (N=209)	Scheduled caste (N=188)	p-value
Any antenatal care						
Yes	49 (10.16%)	15 (20.00%)	0	15 (7.17%)	19 (10.21%)	
No	431 (89.41%)	60 (80.00%)	10 (100%)	194 (92.82%)	167 (89.78%)	
						0.011§
Any tetanus toxoid*						
Yes	238 (49.37%)	51 (68.00%)	4 (40.00%)	99 (47.36%)	84 (44.68%)	
No	244 (50.62%)	24 (32.00%)	6 (60.00%)	110 (52.63%)	104 (55.31%)	
						0.005§
Any Iron Folic Acid						
Yes	72 (14.93%)	16 (21.33%)	0	31 (14.83%)	25 (13.29%)	
No	410 (85.06%)	59 (78.66%)	10 (100%)	178 (85.16%)	163 (86.70%)	
						0.206
Trained birth attendant						
Yes	18 (3.73%)	8 (10.66%)	0	9 (4.32%)	1 (0.53%)	
No	460 (95.43%)	66 (88.00%)	10 (100%)	199 (95.67%)	185 (99.46%)	
						0.001§
Any postpartum care						
Yes	5 (1.03%)	0	0	4 (1.95%)	1 (0.53%)	
No	472 (99.00%)	75 (100%)	10 (100%)	201 (98.04%)	186 (99.46%)	
						0.394
Contraceptive†						
Yes	39 (8.09%)	12 (16.00%)	0	16 (8.16%)	11 (5.88%)	
No	427 (88.58%)	61 (81.33%)	10 (100%)	180 (91.83%)	176 (94.11%)	
						0.035§
Treatment outside home‡						
Yes	31 (6.43%)	4 (5.33%)	0	18 (8.61%)	9 (4.78%)	
No	451 (93.56%)	71 (94.66%)	10 (100%)	191 (91.38%)	179 (95.21%)	
						0.343

*Either during the pregnancy of 1998-99 or previous pregnancy. †At the time of the interview. ‡For a life threatening complication experienced either during pregnancy, labor and delivery, or postpartum. Data were missing for 2 (0.4%) women for any antenatal care, 4 (0.8%) women for trained birth attendant, 5 (1%) women for any postpartum care, and 16 (3.3%) women for contraceptive use. §$p<0.05$

APPENDIX G

Maternal healthcare services utilization by three caste groups for the women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=472)	Higher caste (N=75)	Backward class (N=209)	Scheduled caste (N=188)	p-value
Any antenatal care					
Yes	49 (10.38%)	15 (20.00%)	15 (7.17%)	19 (10.21%)	
No	421 (89.19%)	60 (80.00%)	194 (92.82%)	167 (89.78%)	
					0.008§
Any tetanus toxoid*					
Yes	238 (50.63%)	51 (68.00%)	99 (47.36%)	84 (44.68%)	
No	234 (49.57%)	24 (32.00%)	110 (52.63%)	104 (55.31%)	
					0.002§
Any Iron Folic Acid					
Yes	72 (15.25%)	16 (21.33%)	31 (14.83%)	25 (13.29%)	
No	400 (84.74%)	59 (78.66%)	178 (85.16%)	163 (86.70%)	
					0.255
Trained birth attendant					
Yes	18 (3.81%)	8 (10.66%)	9 (4.32%)	1 (0.53%)	
No	450 (95.33%)	66 (88.00%)	199 (95.67%)	185 (99.46%)	
					<0.001§
Any postpartum care					
Yes	5 (1.05%)	0	4 (1.95%)	1 (0.53%)	
No	462 (97.88%)	75 (100%)	201 (98.04%)	186 (99.46%)	
					0.244
Contraceptive†					
Yes	39 (8.26%)	12 (16.00%)	16 (8.16%)	11 (5.88%)	
No	417 (88.34%)	61 (81.33%)	180 (91.83%)	176 (94.11%)	
					0.023§
Treatment outside home‡					
Yes	31 (6.56%)	4 (5.33%)	18 (8.61%)	9 (4.78%)	
No	441 (93.43%)	71 (94.66%)	191 (91.38%)	179 (95.21%)	
					0.275

*Either during the pregnancy of 1998-99 or previous pregnancy. †At the time of the interview. ‡For a life threatening complication experienced either during pregnancy, labor and delivery, or postpartum. Data were missing for 2 (0.4%) women for any antenatal care, 4 (0.8%) women for trained birth attendant, 5 (1%) women for any postpartum care, and 16 (3.3%) women for contraceptive use. §$p<0.05$

APPENDIX H

Adjusted residuals indicating the caste group with outstanding maternal healthcare services utilization* for the women from four caste groups who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=482)	**Higher caste (N=75)**	**Other backward caste (N=10)**	**Backward class (N=209)**	**Scheduled caste (N=188)**
Any antenatal care					
Yes	49 (10.16%)	15 (20.00%)	0	15 (7.17%)	19 (10.21%)
Adjusted residuals		**3.0**	-1.1	-1.9	0.0
No	431 (89.41%)	60 (80.00%)	10 (100%)	194 (92.82%)	167 (89.78%)
Adjusted residuals		-3.0	1.1	1.9	0.0
Any tetanus toxoid†					
Yes	238 (49.37%)	51 (68.00%)	4 (40.00%)	99 (47.36%)	84 (44.68%)
Adjusted residuals		**3.5**	-0.6	-0.8	-1.6
No	244 (50.62%)	24 (32.00%)	6 (60.00%)	110 (52.63%)	104 (55.31%)
Adjusted residuals		-3.5	0.6	0.8	1.6
Trained birth attendant					
Yes	18 (3.73%)	8 (10.66%)	0	9 (4.32%)	1 (0.53%)
Adjusted residuals		**3.5**	-0.6	0.6	-3.0
No	460 (95.43%)	66 (88.00%)	10 (100%)	199 (95.67%)	185 (99.46%)
Adjusted residuals		-3.5	0.6	-0.6	3.0
Contraceptive‡					
Yes	39 (8.09%)	12 (16.00%)	0	16 (8.16%)	11 (5.88%)
Adjusted residuals		**2.7**	-1.0	-0.1	-1.6
No	427 (88.58%)	61 (81.33%)	10 (100%)	180 (91.83%)	176 (94.11%)
Adjusted residuals		-2.7	1.0	0.1	1.6

*Only for the maternal healthcare services that significantly varied by caste affiliation, $p<0.10$. Numbers in bold indicate the caste group with unusually high adjusted residuals.
†Either during the pregnancy of 1998-99 or previous pregnancy. ‡At the time of the interview. Data were missing for 2 (0.4%) women for any antenatal care, 4 (0.8%) women for trained birth attendant, 5 (1%) women for any postpartum care, and 16 (3.3%) women for contraceptive use.

APPENDIX I

Adjusted residuals indicating the caste group with outstanding maternal healthcare services utilization* for the women from three caste groups who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India

	All (N=472)	**Higher caste (N=75)**	**Backward class (N=209)**	**Scheduled caste (N=188)**
Any antenatal care				
Yes	49 (10.38%)	15 (20.00%)	15 (7.17%)	19 (10.21%)
Adjusted residuals		**3.0**	-2.1	-0.1
No	421 (89.19%)	60 (80.00%)	194 (92.82%)	167 (89.78%)
Adjusted residuals		-3.0	2.1	0.1
Any tetanus toxoid†				
Yes	238 (50.63%)	51 (68.00%)	99 (47.36%)	84 (44.68%)
Adjusted residuals		**3.5**	-0.9	-1.7
No	234 (49.57%)	24 (32.00%)	110 (52.63%)	104 (55.31%)
Adjusted residuals		-3.5	0.9	1.7
Trained birth attendant				
Yes	18 (3.81%)	8 (10.66%)	9 (4.32%)	1 (0.53%)
Adjusted residuals		**3.4**	0.5	-3.0
No	450 (95.33%)	66 (88.00%)	199 (95.67%)	185 (99.46%)
Adjusted residuals		-3.4	-0.5	3.0
Contraceptive‡				
Yes	39 (8.26%)	12 (16.00%)	16 (8.16%)	11 (5.88%)
Adjusted residuals		**2.6**	-0.3	-1.7
No	417 (88.34%)	61 (81.33%)	180 (91.83%)	176 (94.11%)
Adjusted residuals		-2.6	0.3	1.7

*Only for the maternal healthcare services that significantly varied by caste affiliation, $p<0.10$. Numbers in bold indicate the caste group with unusually high adjusted residuals.
†Either during the pregnancy of 1998-99 or previous pregnancy. ‡At the time of the interview. Data were missing for 2 (0.4%) women for any antenatal care, 4 (0.8%) women for trained birth attendant, 5 (1%) women for any postpartum care, and 16 (3.3%) women for contraceptive use

APPENDIX J

Demographic characteristics of the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by three caste groups

	All (N=454)	**Higher caste (N=71)**	**Backward class (N=199)**	**Scheduled caste (N=184)**	**p-value**
Gender of the neonate					
Male	233 (51.32%)	38 (53.52%)	97 (48.74%)	96 (52.17%)	
Female	221 (48.67%)	33 (46.47%)	102 (51.25%)	86 (46.73%)	0.624
Maternal age (completed years)					
Mean	27.23	26.37	27.20	27.59	
Median	27.00	26.00	27.00	27.00	
Standard Deviation	5.07	4.44	5.21	5.14	0.224
Maternal parity					
Mean	3.67	3.11	3.52	3.89	
Median	3.00	3.00	3.00	3.00	
Standard Deviation	2.19	1.60	2.24	2.30	0.030*
Number of living brothers					
Mean	0.98	0.66	1.06	1.01	
Median	1.00	0.00	1.00	1.00	
Standard Deviation	1.09	0.77	1.14	1.13	0.027*
Socio-economic status score					
Mean	9.55	11.54	10.26	8.02	
Median	8.00	11.00	9.00	7.00	
Standard Deviation	5.26	4.52	5.73	4.56	<0.001*
Maternal literacy					
Literate	156 (34.36%)	44 (61.97%)	78 (39.19%)	34 (18.47%)	
Somewhat literate	45 (9.91%)	11 (15.49%)	16 (8.04%)	18 (9.78%)	
Illiterate	253 (55.72%)	16 (22.53%)	105 (52.76%)	132 (71.73%)	<0.001*

Data were missing for only one (0.2%) neonate for maternal age and socio-economic status score. *$p<0.05$

APPENDIX K

Scheffe post-hoc analysis and examination of adjusted residuals indicating the caste group with outstanding demographic characteristics* for the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by four caste groups

	All (N=464)	**Higher caste (N=71)**	**Other backward caste (N=10)**	**Backward class (N=199)**	**Scheduled caste (N=184)**	**Subset A**	**Subset B**
Mean maternal age (completed years)	27.35	26.37	32.70	26.20	27.59	Higher caste, Backward class, Scheduled caste, **p=0.814**	Other backward class, **p=1.000**
Mean maternal parity	3.67	3.11	6.40	3.52	3.89	Higher caste, Backward class, Scheduled caste, **p=0.566**	Other backward class, **p=1.000**
Mean number of living brothers	1.00	0.66	2.20	1.06	1.01	Higher caste, Backward class, Scheduled caste, **p=0.563**	Other backward class, **p=1.000**
Mean socio-economic status score	9.58	11.54	10.90	10.26	8.02	Higher caste, Other backward class, Backward class, Scheduled caste, p=0.055	
Maternal literacy							
Literate	156 (33.62%)	44 (61.97%)	0	78 (39.19%)	34 (18.47%)	N/A	N/A
Adjusted residuals		**5.5**	-2.3	2.2	-5.6		
Somewhat literate	45 (9.69%)	11 (15.49%)	0	16 (8.04%)	18 (9.78%)	N/A	N/A
Adjusted residuals		1.8	-1.0	-1.0	0.0		
Illiterate	263 (56.68%)	16 (22.53%)	10 (100%)	105 (52.76%)	132 (71.73%)	N/A	N/A
Adjusted residuals		-6.3	2.8	-1.5	**5.3**		

*Only for the demographic characteristics that significantly varied by caste affiliation, p<0.10. Subset for alpha=0.05. Numbers in bold (high p-value and adjusted residuals) indicate statistical significance.

APPENDIX L

Scheffe post-hoc analysis and examination of adjusted residuals indicating the caste group with outstanding demographic characteristics* for the neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by three caste groups

	All (N=454)	**Higher caste (N=71)**	**Backward class (N=199)**	**Scheduled caste (N=184)**	**Subset A**	**Subset B**
Mean maternal parity	3.67	3.11	3.52	3.89	Higher caste, Backward class, p=0.340	Backward class, Scheduled caste, p=0.418
Mean number of living brothers	0.98	0.66	1.06	1.01	Higher caste, **p=1.000**	Scheduled caste, Backward class, **p=0.939**
Mean socio-economic status score	9.55	11.54	10.26	8.02	Scheduled caste, **p=1.000**	Backward class, Higher caste, p=0.149
Maternal literacy						
Literate	156 (34.36%)	44 (61.97%)	78 (39.19%)	34 (18.47%)	N/A	N/A
Adjusted residuals		**5.3**	1.9	-5.9		
Somewhat literate	45 (9.91%)	11 (15.49%)	16 (8.04%)	18 (9.78%)	N/A	N/A
Adjusted residuals		1.7	-1.2	-0.1		
Illiterate	253 (55.72%)	16 (22.53%)	105 (52.76%)	132 (71.73%)	N/A	N/A
Adjusted residuals		-6.1	-1.1	**5.7**		

*Only for the demographic characteristics that significantly varied by caste affiliation, p<0.10. Subset for alpha=0.05. Numbers in bold (high p-value and adjusted residuals) indicate statistical significance.

APPENDIX M

Neonatal care and healthcare services utilization among neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by four caste groups

	All (N=464)	Higher caste (N=71)	Other backward caste (N=10)	Backward class (N=199)	Scheduled caste (N=184)	p-value
Aseptic cord cut						
Yes	345 (74.35%)	51 (71.83%)	7 (70.00%)	137 (68.84%)	150 (81.52%)	
No	118 (25.43%)	20 (28.16%)	3 (30.00%)	62 (31.15%)	33 (17.93%)	
						0.028†
Aseptic cord tie						
Yes	33 (7.11%)	7 (9.85%)	0	14 (7.03%)	12 (6.52%)	
No	431 (92.88%)	64 (90.14%)	10 (100%)	185 (92.96%)	172 (93.47%)	
						0.642
Aseptic cord dressing (at the day of birth)						
Yes	53 (11.42%)	7 (9.85%)	4 (40.00%)	30 (15.07%)	12 (6.52%)	
No	410 (88.36%)	64 (90.14%)	6 (60.00%)	168 (84.42%)	172 (93.47%)	
						0.002†
Aseptic cord dressing (until cord fell off)						
Yes	18 (3.87%)	3 (4.22%)	2 (20.00%)	10 (5.02%)	3 (1.63%)	
No	442 (95.25%)	68 (95.77%)	8 (80.00%)	187 (93.96%)	179 (97.28%)	
						0.018†
Any routine neonatal care						
Yes	9 (1.93%)	1 (1.40%)	0	5 (2.51%)	3 (1.63%)	
No	451 (97.18%)	70 (98.59%)	10 (100%)	192 (96.48%)	179 (97.28%)	
						0.862
Treatment outside home*						
Yes	9 (1.93%)	3 (4.22%)	0	3 (1.50%)	3 (1.63%)	
No	455 (98.06%)	68 (95.77%)	10 (100%)	196 (98.49%)	181 (98.36%)	
						0.487

*For a life threatening complication experienced either on the first day of birth or during 2-28 days. Data were missing for 1 (0.2%) neonate for aseptic cord cut, 1 (0.2%) neonate for aseptic cord dressing-at the day of birth, for 4 (0.9%) neonates for aseptic cord dressing- until cord fell off, and 4 (0.9%) neonates for routine neonatal care utilization. †$p<0.05$

APPENDIX N

Neonatal care and healthcare services utilization among neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by three caste groups

	All (N=454)	**Higher caste (N=71)**	**Backward class (N=199)**	**Scheduled caste (N=184)**	**p-value**
Aseptic cord cut					
Yes	338 (74.44%)	51 (71.83%)	137 (68.84%)	150 (81.52%)	
No	115 (25.33%)	20 (28.16%)	62 (31.15%)	33 (17.93%)	
					0.011†
Aseptic cord tie					
Yes	33 (7.26%)	7 (9.85%)	14 (7.03%)	12 (6.52%)	
No	421 (92.73%)	64 (90.14%)	185 (92.96%)	172 (93.47%)	
					0.646
Aseptic cord dressing (at the day of birth)					
Yes	49 (11.67%)	7 (9.85%)	30 (15.07%)	12 (6.52%)	
No	404 (88.98%)	64 (90.14%)	168 (84.42%)	172 (93.47%)	
					0.024†
Aseptic cord dressing (until cord fell off)					
Yes	16 (3.52%)	3 (4.22%)	10 (5.02%)	3 (1.63%)	
No	442 (95.59%)	68 (95.77%)	187 (93.96%)	179 (97.28%)	
					0.187
Any routine neonatal care					
Yes	9 (1.98%)	1 (1.40%)	5 (2.51%)	3 (1.63%)	
No	441 (97.13%)	70 (98.59%)	192 (96.48%)	179 (97.28%)	
					0.766
Treatment outside home*					
Yes	9 (1.98%)	3 (4.22%)	3 (1.50%)	3 (1.63%)	
No	445 (98.01%)	68 (95.77%)	196 (98.49%)	181 (98.36%)	
					0.335

*For a life threatening complication experienced either on the first day of birth or during 2-28 days. Data were missing for 1 (0.2%) neonate for aseptic cord cut, 1 (0.2%) neonate for aseptic cord dressing-at the day of birth, for 4 (0.9%) neonates for aseptic cord dressing- until cord fell off, and 4 (0.9%) neonates for routine neonatal care utilization. †$p<0.05$.

APPENDIX O

Neonatal care and healthcare services utilization* among neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by four caste groups

	All (N=464)	Higher caste (N=71)	Other backward caste (N=10)	Backward class (N=199)	Scheduled caste (N=184)
Aseptic cord cut					
Yes	345 (74.35%)	51 (71.83%)	7 (70.00%)	137 (68.84%)	150 (81.52%)
Adjusted residuals		-0.6	-0.3	-2.4	**3.0**
No	118 (25.43%)	20 (28.16%)	3 (30.00%)	62 (31.15%)	33 (17.93%)
Adjusted residuals		0.6	0.3	2.4	-3.0
Aseptic cord dressing (at the day of birth)					
Yes	53 (11.42%)	7 (9.85%)	4 (40.00%)	30 (15.07%)	12 (6.52%)
Adjusted residuals		-0.5	**2.9**	2.2	-2.7
No	410 (88.36%)	64 (90.14%)	6 (60.00%)	168 (84.42%)	172 (93.47%)
Adjusted residuals		0.5	-2.9	-2.2	2.7
Aseptic cord dressing (until cord fell off)					
Yes	18 (3.87%)	3 (4.22%)	2 (20.00%)	10 (5.02%)	3 (1.63%)
Adjusted residuals		0.1	**2.7**	1.1	-2.0
No	442 (95.25%)	68 (95.77%)	8 (80.00%)	187 (93.96%)	179 (97.28%)
Adjusted residuals		-0.1	-2.7	-1.1	2.0

*Only for the neonatal healthcare services that significantly varied by caste affiliation, $p<0.10$. Numbers in bold indicate the caste group with unusually high adjusted residuals. Data were missing for 1 (0.2%) neonate for aseptic cord cut, 1 (0.2%) neonate for aseptic cord dressing-at the day of birth, and for 4 (0.9%) neonates for aseptic cord dressing-until cord fell off.

APPENDIX P

Neonatal care and healthcare services utilization* among neonates born to women who were pregnant during January 1998 to January 1999 in Maitha, Uttar Pradesh, India by three caste groups

	All (N=454)	**Higher caste (N=71)**	**Backward class (N=199)**	**Scheduled caste (N=184)**
Aseptic cord cut				
Yes	338 (74.44%)	51 (71.83%)	137 (68.84%)	150 (81.52%)
Adjusted residuals		-0.6	-2.5	**3.0**
No	115 (25.33%)	20 (28.16%)	62 (31.15%)	33 (17.93%)
Adjusted residuals		0.6	2.5	-3.0
Aseptic cord dressing (at the day of birth)				
Yes	49 (11.67%)	7 (9.85%)	30 (15.07%)	12 (6.52%)
Adjusted residuals		-0.3	**2.6**	-2.4
No	404 (88.98%)	64 (90.14%)	168 (84.42%)	172 (93.47%)
Adjusted residuals		0.3	-2.6	2.4

*Only for the neonatal healthcare services that significantly varied by caste affiliation, $p<0.10$. Numbers in bold indicate the caste group with unusually high adjusted residuals. Data were missing for 1 (0.2%) neonate each for aseptic cord cut and aseptic cord dressing-at the day of birth.