SPATIAL DIFFERENTIALS IN FERTILITY AND THE 0-6 YEAR SEX RATIO IN INDIA, BY DISTRICT: 2001

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ABSTRACT

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Most countries have a fairly stable sex ratio, however, in societies where there is a marked preference for male children a different pattern is seen, one where population sex ratios are male dominant. This is the case for India, a country with an historical and cultural basis for son preference. Findings from India's 2001 census confirm that excess female mortality persists in much of India, even as the country experiences rapid declines in fertility levels. The objective of this study is twofold: (1) to understand the spatial differentials in total fertility rates and the 0-6 year child sex ratio in India and (2) to investigate the relationship between these two demographic indicators. Cultural, socio-economic, demographic, and geographic determinants of fertility and the sex ratio were examined in a multivariate framework using district-level data from the 2001 census. Findings conclude that region matters when explaining the spatial variation in fertility and the sex ratio but that no correlation exists between them. Female literacy had the greatest impact on fertility decline, whereas the sex ratio was affected by cultural factors.

CHAPTER 1

INTRODUCTION TO THE STUDY

A significant sex bias in mortality exists in many parts of the developing world, including India, the research area for this study. Excess female mortality, a phenomenon that occurs when a much higher male to female sex ratio exists, is the result of this gender bias. It happens when discriminatory treatment offsets the natural lower mortality rate of females: females born into such societies are neglected and therefore receive a lack of proper attention, less food, and inferior medical care; infant females are victims of infanticide; female fetuses are terminated following prenatal sex identification.

"It is well known that the composition of India's population by sex became increasingly (and unusually) masculine during the twentieth century; and it has been suggested that this trend may continue into the twenty-first century (Dyson 2001, 343). Several studies have explored how the discriminatory treatment of females offsets their natural lower mortality rate, and while there is no longer much interest in the general question of whether a higher male to female sex ratio exists—as it has been the topic of debate for some decades—the focus has shifted to the investigation of the finer details of sex differences in mortality and the factors responsible for Indian patterns of sex preference (Basu 1992). Add India's declining fertility to these patterns of sex preference, and it is interesting to see how the country's demographic profile is changing.

India is facing other big changes: the country is in a period of transition, fluctuating between tradition and modernity. Old customs are colliding with modern ideas, and "it is against this background of a traditional society in transition, a situation of fluidity, [that] the problem of daughter discrimination needs to be conceptualized" (Larsen et al. 2005), especially as it is quite possible that parents are choosing to fall back on traditional beliefs regarding sex preference as they face uncertainty about a modernizing India.

The objective of this study is twofold: (1) to understand the spatial differentials in total fertility rates and the child sex ratio in India and (2) to investigate the relationship between fertility levels and the sex ratio. Determinants of fertility and the child sex ratio are examined in a multivariate framework using district-level data from the 2001 Census of India.

CHAPTER 2

RESEARCH QUESTIONS AND JUSTIFICATION FOR THE STUDY

Driven by two major research questions, this study concentrates on patterns of the total fertility rate and the 0-6 year child sex ratio in India, in an attempt to uncover what factors are responsible for the spatial variations seen in these two demographic indicators. First, using regression, what demographic or geographic factors might explain spatial variability in fertility and the child sex ratio in India? Embedded in this question are social, economic, cultural, and regional issues.

Also, due to large regional differences in fertility decline and the sex ratio at birth, a question being raised in the literature is whether fertility decline has altered former "regional differentials in the manifestations of sex discrimination" (Das Gupta and Bhat 1997, 312). With India experiencing an overall shift towards lower fertility, question two asks if this trend is negatively impacting the child sex ratio pattern observed across the country.

Justification

This study contributes to an ongoing scholarly debate. The literature is full of contradictory results (Murthi et al. 1995) as to which explanatory variables have the most power to describe the regional variations in fertility decline and female disadvantage, as illustrated by India's masculine sex ratios. There are also conflicting claims as to how these variables affect fertility decline and the sex ratio, i.e. does sex discrimination diminish with higher or lower female literacy rates or with higher or lower rates of female employment? A more thorough examination of these questions can be found in the literature review (Chapter 3).

Factors influencing the reductions of fertility in India, "whether they are the effect primarily of such general changes as lowered infant mortality, increasing education, urban rather than rural residence, and improving status of women, or of such particular changes as spreading knowledge of and access to efficient methods of contraception or abortion," are strongly debated, and adding interest to this demographic development is the country's position of being the first developing nation to officially support family planning programs, including a variety of birth control programs (Bhat et al. 1984).

CHAPTER 3

BACKGROUND AND LITERATURE REVIEW

Sex ratios at birth refer to the ratio of male to female children born over a specific time period. This is generally represented as the number of males per 100 females, with higher ratios corresponding to higher relative numbers of males. The sex ratio can also be represented as the number of girls per 1000 boys, as is the case with Indian census data.

In most populations, more boys than girls are conceived and born, but when given the same care, mortality rates at every age are slightly higher for males than females due to behavioral and biological factors. This leads to a fairly stable sex ratio, a pattern most societies develop. However, in societies where there is a marked preference for male children (Sudha and Rajan 1999) and where women are in subordinate positions to men and are culturally, socially, and economically dependent on them (Fikree and Pasha 2004), a different pattern is seen, one where population sex ratios are male dominant. While this is somewhat uncommon, it is the prevailing pattern observed in India, a country with an historical and cultural basis for son preference.

That female mortality rates are naturally lower than those of men is basically an undisputed fact (Sen 1990; Coale 1991; Das Gupta and Bhat 1997; Sudha and Rajan 1999), so why does excess female mortality occur so often in the developing world?

A review of the literature reexamines past studies concerning excess female mortality. This is followed by an overview of India's demographic history and a review of studies concerned with India's declining fertility rates and skewed sex ratio.

Missing Women

Several studies emphasize the adverse female to male sex ratios and attempt to calculate the numbers of "missing women" from the population totals in East and South Asia (Croll 2002). The concept of "missing women" was brought to the forefront of academic and scientific debate with Amartya Sen's (Sen 1990) groundbreaking editorial, "More than 100 Million Women are Missing." In it, Sen compared the ratios of women to men in the United States and Europe to those in South Asia, concluding that the lower rates in Asia were due to excess female mortality caused by gender bias in the allocation of nutrition, resources, and health care—he calculated a total of over 100 million women "missing" from the population (Sen 1990; Croll 2002; Klasen and Wink 2003).

Demographer Ansley Coale agreed with Sen, identifying excess female mortality as the major cause of high male to female ratios observed in these populations (Coale 1991); Coale refined Sen's calculations, taking into consideration the high losses of males due to war and intercontinental differences in age structures; this gave him a total of sixty million missing females from the populations of East and South Asia (Coale 1991; Croll 2002).

Stephen Klassen attempted to resolve the differences in these two calculations by introducing a modified non-discriminatory standard for assessing excess female mortality; using this standard, he calculated that ninety million females were missing

(Klassen 1994). Klassen and Claudia Wink revisited the debate of missing women, noting that in the decade following the previous studies, the number of missing women had increased in absolute terms but fallen in terms of the number of women alive; they concluded that improvements in female education and employment reduce sex bias whereas resorting to sex-selective abortions increases the bias (Klassen and Wink 2003).

Attempts have also been made to calculate the number of missing women in India. Taking complete equality as a base, Satish Agnihotri calculated that in 1991 approximately thirty-two million Indian women were missing from the population (Agnihotri 1995; Mayer 1999). The increasing use of reproductive technologies to avoid the birth of daughters—what leads to masculine sex ratios—can largely be accredited to son preference.

Son Preference

In many societies prospective parents, both men and women, tend to prefer sons over daughters. “Son preference involves some or all of the following desires: (1) that if there is to be just one child in the family, that one be male; (2) that if there are to be several children, there be more males than females; and (3) that the firstborn child be male” (Warren 1985). Son preference, and accordingly an increase in sex ratio, is most marked in strong patriarchy societies, patriarchy being “the type of social system which ensures male control of women and (other) resources” (Warren 1985).

India has an historical basis for son preference (Khanna 1997), as sons are perceived to have economic, social, and religious utility, whereas daughters are seen as an economic liability, mostly because of India’s dowry system (Fikree and Pasha 2004).

Sons carry the family name and occupation forward into the future; they perform religious rites and support their aging parents; consequently, females must be married off.

Sex discrimination, in the attempt to gain sons, has occurred at each stage of the female life cycle for centuries (Fikree and Pasha 2004), namely female infanticide and the neglect of female children. Recently, these forms of female disadvantage in mortality have been substantially reduced, but this has been counterbalanced by a new disadvantage that occurs in natality: sex-specific abortions aimed against the female fetus (Sen 2003).

Son preference in combination with India's rapid decline in desired family size and fertility has led to the increasing use of sex-selective abortion following prenatal sex determination (Khanna 1997): "When fertility declines, the total number of children that couples desire falls more rapidly than the total number of desired sons. The differences in speed of these two trajectories narrows the space left for daughters, and results in greater pressure to remove girls" (Das Gupta and Bhat 1997, 307). To illustrate, in northern India—where son preference is especially high—a woman's desired family size is positively associated with her level of son preference, and as fertility declines, the increasing availability of prenatal sex-selective technology allows her to realize her repressed desire for sons, outweighing the influence declining son preference could have on the sex ratio (Bhat and Zavier 2003).

Demographic History, Fertility, and the Sex Ratio

India is currently experiencing a rapid change in its demographic profile. As seen in several developing countries, mortality rates in India have declined considerably in the past few decades. During this period, India has also witnessed a prolonged fertility decline, especially in Southern India where, for example, the state of Tamil Nadu experienced a reduction in the total fertility rate from 3.5 to 2.2 during the 1980s (Murthi et al. 1995). In addition, there have been significant changes in the relative survival chances of men versus women (Murthi et al. 1995), contributing to the male biased sex ratios seen in India. "The sex differential in child mortality seems to make a substantial, probably the largest, contribution to India's abnormally low female-male ratio…[yet] fertility and child mortality rates have both been declining in India in recent years" (Bhattacharya 2006, 263). To better understand these demographic shifts, it is necessary to be familiar with India's demographic history.

India has a long history of census-taking going back to British India's first national census in 1871. That first census confirmed for all of India what had previously been witnessed in certain districts and villages in northern India, that there were fewer women than men, approximately 100 males to 94 females, or six percent more males than females (Mayer 1999).

"Not only has the proportion of females in India remained low over the past twelve decades, but—to the mystification of Indian demographers—the sex ratio has fallen, almost without exception, by roughly one percent at each decennial enumeration in the twentieth century" (Mayer 1999, 323). Those few exceptions, when the rise in population masculinity was briefly overturned, occurred during enumerations in the decades following three specific censuses: the census of 1941 during which census operations were affected by wartime restrictions, the census of 1971 when Prime Minister Indira Gandhi delayed the census by calling an election, and the census of 1991 (Dyson

2001). Therefore, it makes sense that these brief turnarounds in the sex ratio, as witnessed in the censuses of 1951, 1981, and 2001, occurred mainly due to an upturn toward more normal levels of census coverage: "to express the point differently, the slight declines in population masculinity in 1951, 1981, and 2001 probably reflect the fact that females in particular were better counted in these censuses than in the immediately preceding enumerations (i.e. those of 1941, 1971, and 1991)" (Dyson 2001, 343), and therefore, India is still considered to be continuing its downward trend towards more biased sex ratios.

Censuses from the twentieth century also reveal pronounced regional variation in India's sex ratios. The highest male dominated sex ratios are found in northwestern India, especially in the states of Punjab, Haryana, the western part of Uttar Pradesh, Rajasthan, and the northern part of Madhya Pradesh; the most equal sex ratios are found in south India, most notably in the states of Kerala and Tamil Nadu (Mayer 1999).

Results from the 2001 census were highly anticipated, it being the first census since 1971 to effectively cover all of India, including the states of Jammu and Kashmir and Assam. Once again, the northern states were shown to have particularly masculine sex ratios, with sex ratios being highest in Haryana and Punjab, but also high in Uttar Pradesh, Gujarat, Rajasthan, Maharashtra, and Bihar, reflecting long-term regional patterns of sex bias in mortality (Dyson 2001). Most states had less biased population sex ratios, and while this most likely reflects improvements in female enumeration, the decline in some states may indicate real change—however, in Punjab, Haryana, Maharashtra, and Gujarat, the population sex ratio has risen (Dyson 2001).

In contrast to examining the overall population sex ratio, this study examines the 0-6 year child sex ratio. Unfortunately, this index has risen in every state except Kerala since the last enumeration. The increase has been modest for most states, but in Punjab and Haryana—states that already had extremely biased sex ratios at birth—and Maharashtra and Gujarat, the rise has been extremely sharp since 1991 (Dyson 2001). What is even more alarming is that these four states are among the wealthier Indian states (Sen 2001), leading to the belief that sex-identification technology is widely available and sex-selective abortion is being extensively practiced, especially in areas where daughter discrimination is more commonplace.

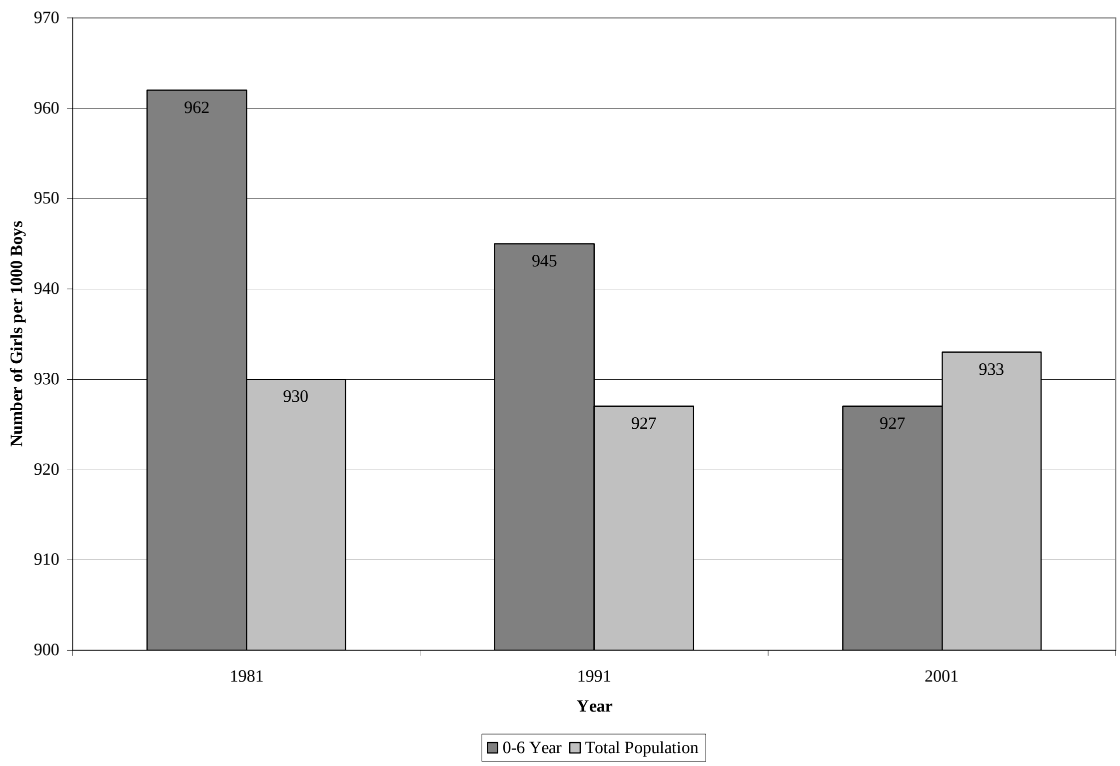

Figure 1. Sex Ratio Trends in India: 0-6 Years vs. Total Population
Source: Census of India

There is agreement in the literature that India's high male to female sex ratios are a bleak indicator of the relatively inferior position women continue to have in Indian society (Mayer 1999). An early study of the regional differences in Indian sex ratios questioned whether masculine sex ratios result from the inferior economic value of females or from greater discrimination against females (Miller 1981; Mayer 1999). Hypothesizing that in areas where the demand for female labor is high there will be correspondingly higher survival rates for females, and using district-level data from the 1961 census, a moderately strong correlation was found to exist between female workforce participation rates and the juvenile sex ratio (Miller 1981; Mayer 1999). This finding suggests that by increasing the economic value of women, their survival chances increase, and this is reflected in an equalizing sex ratio.

What about India's fertility transition? Fertility has been declining in India, but the decline has taken place at varying levels and speeds across the country. To understand the mechanisms behind the regional variations in India's fertility transition, the transition (1951-1991) was reconstructed, examining fertility as a regionalized variable (Guilmoto and Rajan 2001). Using cluster analysis, with districts as observation units and five year fertility estimates as variables, India's districts were divided into three fertility profiles, those that experienced (1) early fertility decline, (2) intermediate fertility decline, and (3) late fertility decline. Mapping the transition showed that fertility decline began in India's periphery, along the coasts and in the extreme south; fertility decline then spread progressively inward, gradually moving north, to encircle the region surrounding the Ganges Valley, the heart of Hindi-speaking traditional India, where fertility has hardly declined (Guilmoto and Rajan 2001).

Why is fertility declining in India? There is a debate as to whether that status of women, or women's agency, has the greatest impact on fertility or if an economic influence is more important (Bhattacharya 2006). One cross-sectional analysis of the total fertility rate in India found that female literacy and female work force participation had a negative effect on fertility and were the only two variables to be statistically significant; another finding of this analysis was that fertility is lower in the southern and western regions of India and in districts with higher proportions of the population belonging to a scheduled tribe (Murthi et al. 1995). However, in a study of economic development, sex bias, and demographic outcomes in India, variables reflecting levels of development and modernization had the greatest impact, contrary to the general belief that female agency has the greatest influence in lowering fertility (Bhattacharya 2006).

There are arguments that one outcome of declining fertility is the sharp rise in the sex ratio at birth, suggesting that, in societies marked by strong son preference, fertility decline is supplemented by excess female mortality (Das Gupta and Bhat 1997). Basically, in areas characterized by son preference, as fertility declines, the number of unwanted daughters is always greater than the number of unwanted sons (Bhat and Zavier 2003).

A study that examined the relationship between fertility decline and the net manifestation of sex bias found that fertility decline in India has increased female children's disadvantage in mortality, creating a greater disparity in the child sex ratio (Das Gupta and Bhat 1997); and an analysis of demographic narratives came to the same conclusion: that a correlation exists between excess female mortality and the preference for smaller families and fertility decline (Croll 2002). So there is evidence, as seen in previous research, that fertility decline in India is accompanied by increases in the 0-6 year male to female sex ratio.

As witnessed in this review of the literature, there is no definitive answer as to which explanatory variables have the most power to describe the regional variations in India's fertility decline and masculine sex ratios. This study attempts to fill the gap in our understanding of the regional variability of fertility decline and the child sex ratio, contributing to the scholarly debate on this subject.

CHAPTER 4

THEORETICAL FRAMEWORK

When developing a theoretical framework in which to base a study akin to India's patterns of fertility and the child sex ratio, it is necessary to summarize the source wherein the proposed framework takes root, in this case human geography. A core sub-discipline of geography, human geography concentrates on the processes and consequences of the spatial distribution of human activity on the surface of the Earth. The fields that comprise human geography are many, encompassing cultural, social, political, and economic aspects of human interaction with the environment. Two fields appropriate for the analysis of human geographical issues, such as the study of fertility and sex ratio patterns, are population geography and feminist geography.

Overview of Population Geography

Population geography examines population growth and change by studying spatial variations in population composition, distribution, and migration in order to distinguish how these factors are related to the nature of place. Traditionally, the discipline has focused on three major themes—fertility, mortality, and migration—but in recent years, the focus has shifted to migration studies, with studies on fertility and mortality being virtually non-existent (Boyle 2003). This dearth of fertility research by geographers is unfortunate given that a geographical perspective has the ability to clarify many questions arising from changing patterns of fertility levels. The lack of interest in contemporary patterns of fertility change is particularly disappointing as studies in other disciplines have demonstrated “the importance of a geographical interpretation of fertility trends and issues” (Boyle 2003, 616).

Even the relevance of population research in the field of geography has undergone questioning since it has, to some extent, been bypassed by the postmodern reinvention of human geography, a result of recent developments in critical disciplines, including feminist geography. Unfortunately, these developments have been disregarded by many population geographers. “In recent years, population geography has become increasingly marginalized within its parent discipline as a result of its failure to engage with the ‘new’ human geographies” (Graham and Boyle 2001, 389); the result is that geographic study of population garners less importance than it arguably deserves. It is time for population geography to embrace the new human geographies, thus opening the door for such studies as those that examine fertility and mortality rates through the lens of feminist geography.

Overview of Feminist Geography

Feminist geography is a branch of human geography that investigates geographic differences in gender equality and gender relations by applying the methods and critiques of feminism to the study of humans and their relationship with society and the environment. As part of a postmodern approach to geography, feminist geography is primarily concerned with the real experiences of groups within their own geographic locality, as opposed to focusing on the development of conceptual theory. Asking questions and identifying trends reflecting the geographical nature of women's experiences is central to this thinking: feminism "looks at the world through the lens of gender, while simultaneously seeking to build a world in which gender is no longer a key dimension along which life's possibilities are defined and resources allocated" (Hanson 1992, 570).

Feminist theory, in relation to geographic research, developed following critiques of mainstream positivist social inquiry (Falconer-Al-Hindi 1997). This led to feminist critiques of geography that resulted in the acknowledgement of gender as a legitimate analytical concept in geographic study (Raghuram et al. 1998). The emergence of a feminist reevaluation of research methods was drawn from four theoretical stages: feminist empiricism, socialist feminism, feminist standpoint theory, and feminist post-structuralism (Falconer-Al-Hindi 1997), and while each stage built upon its predecessor in a linear history, each can be used in conjunction with the others to form different methodological strategies for a feminist approach to geographic study (Mattingly and Falconer-Al-Hindi 1995). The basis most applicable for examining the problem of gender bias in mortality and fertility is feminist empiricism.

The goal of feminist empiricism is to make women visible as geographical subjects worthy of study. "Feminist empiricism is based in a particular critique of mainstream research: women are overlooked or misrepresented in mainstream science due to the oversights of male and/or nonfeminist researchers…[the goal, then,] is to produce a more accurate and 'less biased' description of the world by including women"

(Mattingly and Falconer-Al-Hindi 1995, 429). Increasing women's health, social, and economic status in India is part of this goal of feminist empiricism.

Why is a theoretical framework grounded in feminist theory such an important element in the study of fertility rates and the child sex ratio? There are several issues surrounding India's declining fertility that are directly related to women's experiences, most notably issues reflecting son preference and its effect on fertility and the sex ratio. It is hypothesized that as fertility rates decline, the number of desired children is reduced faster that the number of desired sons. This puts pressure on women to eliminate daughters in order to gain their desired number of sons.

Also, the likely social repercussions of sharp declines in the child sex ratio will directly impact Indian women: more girls will be married at a younger age; more girls will prematurely end their education; maternal mortality will increase as a result of early childbearing; and there will be an associated increase in acts of violence against females such as abduction, rape, trafficking, and forced polyandry (UNICEF 2007).

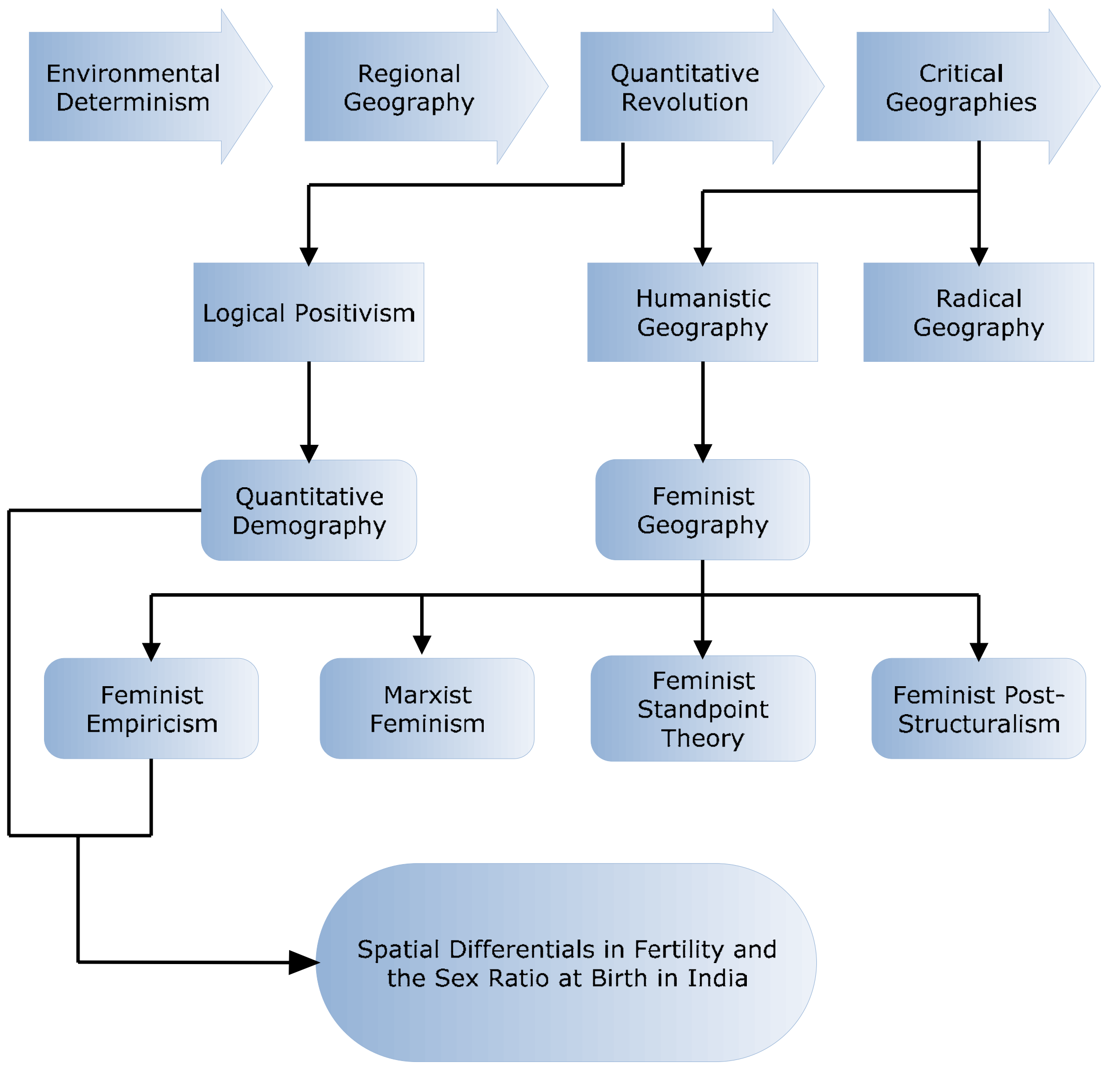

Figure 2. Nesting this Research within Conceptual Geography

CHAPTER 5

METHODOLOGY

With the review of past topic-related studies and theory concluded, it is time to discuss the methodologies used in the geographic interpretation of Indian patterns of fertility and the child sex ratio.

Feminist Methodology

Two questions arise with the decision to incorporate feminist methodological approaches to studies of excess female mortality and sex ratio patterns: (1) what constitutes feminist methodology, and (2) why use feminist methodology to confront the issue of gender bias in mortality? There has been some debate as to whether there is a feminist methodology or whether feminist methods are just an extension of a broader realm of social science methodologies, but there has been some consensus that feminist methodology is about the design of research, data collection, and analysis that involves politicizing a methodology through the use of feminism (Sharp 2005). Therefore a number of methods can be used providing they are consistent with the critiques of feminist thought.

As gender bias in mortality is a topic of debate amongst both Indian and Western feminists, it is logical for feminist methodologies to be incorporated into this type of study. However, this brings up another important concern: should excess female mortality be quantified? Feminist empiricism is exemplified by quantitative-based geographic research that makes visible the spatial dimensions of women's inequality (Mattingly and Falconer-Al-Hindi 1995). The use of quantitative analysis in feminist studies has come full circle, with its accepted use as gender first became a legitimate analytical concept in geographic study, followed by critiques against it as being a masculinist form of analysis, to a renewed interest in empirical study, particularly in gender-sensitive case studies (Mattingly and Falconer-Al-Hindi 1995); therefore it is appropriate to "count women."

It is essential to choose techniques that most closely fit with the proposed study's broader political concerns; this is why feminist researchers, amongst many others, employ into their research design both qualitative and quantitative methods to best meet the aims of their study (Raghuram et al. 1998).

Study Area and Data Sources

This study focuses on the total fertility rate and the 0-6 year child sex ratio across India at the district-level scale. The district, a basic unit of administration, was chosen as the appropriate scale of analysis because it is the lowest level at which spatially disaggregated data on vital demographic indicators, such as fertility and the sex ratio, are available (Dreze and Murthi 2001; Bhattacharya 2006). Few studies assess fertility and sex ratio trends at the district-level (Murthi et al. 1995; Guilmoto and Rajan 2001), nevertheless, the district is a more appropriate scale of analysis than the more commonly used state-level as Indian States oftentimes conceal considerable intraregional variations. Data are obtained from the 2001 Census of India.

Statistical Analysis

Multivariate regression analysis was used to examine the relationship between predictors of fertility and the sex ratio at birth. The stepwise method, an automatic procedure for statistical model selection, was chosen because of the large number of potential explanatory variables; this made it possible to develop the regression equation one variable at a time (Williams and Monge 2001); variables were entered into the regression equation using the Statistical Package for Social Sciences (SPSS).

Models examining only a single perspective of India's demographic profile are inadequate (Kishor 1993), therefore it was important that the regression model be able to simultaneously consider the effects of cultural, socio-economic, demographic, and geographic factors. A qualitative review of demographic narratives and census data helped identify the variables tested in the model—conversely, it must be noted that the choice of variables reflects the limitations of available statistical sources that could be obtained from the Indian census at the district-level.

The two dependent variables that were analyzed are the total fertility rate and the sex ratio at birth. Hypothesized independent variables influencing both fertility and the sex ratio are organized into three conceptual categories: cultural factors, socio-economic factors, and geographic factors. A fourth category of demographic factors is used to explain the variance in the sex ratio at birth.

Dependent Variables

Fertility: The total fertility rate of a population is a measure of fertility defined as the average number of children that would be born to a woman over her lifetime if she were to experience current age specific fertility rates throughout her lifetime. A total fertility rate of 2.1 is considered the replacement rate, and a population that reaches a total fertility rate of 2.1 is considered to have a stable population when the effect of migration is not taken into account. The total fertility rate was chosen as a more functional measure of the fertility level than other measurements (such as the crude birth rate) because it is independent of the population's age structure (Murthi et al. 1995). The total fertility rates used for this study were constructed by Guilmoto and Rajan (2002) in their paper on district-level estimates of fertility from India's 2001 census.

The Sex Ratio at Birth: The child sex ratio, used as a surrogate for the sex ratio at birth, is defined by the Indian census as the number of females in the age group 0-6 years per 1000 males in the same age group in the population. It is calculated as:

*Child Sex Ratio = (Number of female children 0-6 / Number of male children 0-6) * 1000*

Independent Variables: Cultural Factors

The first conceptual category contains cultural factors that are hypothesized determinants of both fertility and the sex ratio at birth. These variables are scheduled caste, scheduled tribe, and religion: Hindu, Muslim, Christian, Buddhist, Sikh, and Jain.

Scheduled Caste and Scheduled Tribe: Scheduled castes and scheduled tribes are communities within Indian society that are accorded special status by the Constitution of

India. Traditionally "outcastes", these communities were excluded from the Chaturvarna social system of Hindu society for many centuries. The percentage of India's population belonging to a scheduled caste or scheduled tribe comprises a significant portion of India's overall population, at about 16 and 8 percent respectively. These minority groups are important to study as the organization of their family structures may differ from those of dominant groups (Bhattacharya 2006). Also, "tribal populations have distinct kinship patterns and gender relations, including higher rates of female labor force participation, that may encourage lower fertility" (Dreze and Murthi 2001, 38) and less masculine sex ratios. The operational variables are the percentage of the district population belonging to a scheduled caste and the percentage of the district population belonging to a scheduled tribe.

Religion: Religion reflects much about a population; this is true of India: "social behavior is much influenced by practices which are subject to religious sanction—it is observed that the age of marriage, the practice of remarriage, the occupation of women, etc. vary according to the caste and religious affiliation of the individual" (Nag and Sengupta 1992, 149). Indian society continues to be fundamentally organized on the basis of both caste and religion which in turn shapes the political, economic, and social structure of society and thus affects the course of population change (Nag and Sengupta 1992). It is generally recognized that religion can impact fertility: "differences in fertility are thought to be largely a result of the different values attributed to family size and to differences in the practices and customs governing sexual relations in various religions" (Bhattacharya 2001, 268). Also, as different religions have different values for the status of women, it is hypothesized that religion impacts the sex ratio as well.

Hindus account for the largest proportion of India’s population (85 percent); the proportion of Muslims is steadily increasing, although Jammu and Kashmir is the only state where Muslims are the majority; Christians are the third largest religious group, and two-thirds reside in the southern states; Sikhs are a small majority in most states, although they comprise the majority of the population in Punjab and Haryana (roughly 86 percent); Buddhists and Neo-Buddhists are scattered about the country in small numbers; and Jains are mainly concentrated within two linguistic groups and are mostly in Gujurat and Rajasthan (Nag and Sengupta 1992). Much of the focus in the literature has been on the Muslim population in given areas because fertility rates tend to be higher among Muslims than among other religious communities (Dreze and Murthi 2001) and because women’s agency is seen as being less for Muslim women (Morgan et al. 2002). Variables for religion are Hindu, Muslim, Christian, Buddhist, Sikh, and Jain. They are taken as the percentage of the population practicing a specific religion by district.

Independent Variables: Socio-economic Factors

The second category of conceptual factors includes socio-economic operational variables that are hypothesized determinants of fertility and the child sex ratio. These variables include female literacy rates, female workforce participation rates, urbanization, electricity as the source of lighting, and permanent housing.

Female Education: The female education variable for this study is the rate of female literacy per district. The literacy rate of a population is defined by the Indian census as the percentage of literates to the total population age seven years and above. The female literacy rate is calculated accordingly:

*Female Literacy Rate = (Number of Female Literates / Population Aged 7+) * 1000*

Basic education, especially female education, is now considered one of the most powerful influences on fertility:

> Women's education is the single most important path to higher productivity, lower infant mortality, and lower fertility. The economic returns on investment in women's education are generally comparable to those of men, but the social returns in terms of health and fertility by far exceed what we gain from the education of men. The girl who receives her diploma will have fewer babies than her sister who does not. (Brundtland 1994, 18)

There are several hypothesized reasons as to why female education can be expected to reduce desired family size: (1) educated women are more prone to express resentment at the burden of multiple pregnancies and be more likely to take action to reduce this burden, (2) educated women are more likely to be less dependent on sons for social status and old age security, and (3) educated women are more likely to have higher aspirations for their children and lower expectations from them as labor service providers (Murthi et al. 1995). Being less dependent on sons can also lessen son preference, therefore equalizing the sex ratio at birth. Female education also affects the relationship between desired family size and the planned number of births, reduces infant and child mortality, and increases knowledge of modern methods of contraception (Murthi et al. 1995).

Female education plays a key role in the social development approach to understanding declines in fertility, however the processes through which female education influences fertility are far from understood (Dreze and Murthi 2001). There is much variation in literacy rates across India. The state of Kerala has the highest literacy rates for both sexes, with Gujarat, Maharashtra, Karnataka, Tamil Nadu, and West Bengal having higher literacy rates that the all-India average (Nag and Sengupta 1992). There are considerable differences in literacy rates for urban and rural areas as well: rural areas that are reclassified as urban areas usually have higher literacy rates than the overall rural average but lower rates than the overall urban average, this constituting a sign of development (Nag and Sengupta 1992). However, in all states, the growth rate of literacy has been considerably higher for females compared to males in the decades following 1961 (Nag and Sengupta 1992).

Female literacy's role in human development and empowerment is well founded—in India, as female literacy has increased, fertility and the sex ratio have fallen; the correlation between increased female literacy rates and a less biased sex ratio is very strong at r = .91 (Mayer 1999).

Female Workforce Participation: The workforce participation rate is defined by the Indian census as the percentage of total workers, both main and marginal, to the total population. Female workforce participation is the percentage of women workers, main and marginal, to the total population:

*Female Workforce Participation = (Total Female Workers / Total Population) * 100*

Arguments are made in the literature that increased female workforce participation rates have a negative impact on fertility (Murthi et al. 1995); it is hypothesized that as women enter the workforce, they desire to reduce the encumbrance of multiple births. Looking at sex ratio trends from the twentieth century, declining female employment is strongly correlated with the increasing disparitiy of the sex ratio (Mayer 1999); as less women are employed, the sex ratio becomes more skewed. Because Indian women are often regarded as financial burdens, it is hypothesized that increasing their economic value increases their survival chances. The female employment variable for this study is taken as the female workforce participation rate per district.

Urbanization: The census defines an urban area as follows: all statutory places with a municipality, corporation, cantonment board, or notified town area committee, etc. and a place satisfying the following three criteria simultaneously: having (1) a minimum population of 5,000, (2) at least 75 per cent of the male working population engaged in non-agricultural pursuits, and (3) a population density of at least 400 per sq. km. (1,000 per sq. mile).

It is hypothesized that increased urbanization leads to a decline in fertility: an early noted differential in fertility is the relatively higher number of children born to couples living in rural areas versus couples living in urban areas, therefore, it is expected that districts with a higher proportion of its population living in rural areas will have higher fertility rates (Bhattacharya 2006).

> Urbanization is believed to reduce fertility because children are less likely to contribute to household production and are more difficult to supervise in an urban setting. Insofar as fertility decline is in part a diffusion process, it is also likely to proceed at a faster pace in urban areas where people have greater exposure to mass media as well as wider opportunities to observe and discuss the lifestyles of other social groups. (Dreze and Murthi 2001, 38)

Electricity as the Source of Lighting and Permanent Housing: The percentage of households with electricity as the source of lighting and the percentage of families with permanent housing are used as measures of standard of living and development. However, data on these two variables were only available at the state-level. As such, the values for these variables are used as proxies for the district-level, and the regression model was run both including and excluding these variables.

Independent Variables: Demographic Factors

The third conceptual category contains demographic factors that are hypothesized determinants of the 0-6 year child sex ratio. These are the total fertility rate and the population growth rate.

Total Fertility Rate: The total fertility rate will be used as a determinant of the sex ratio as it is hypothesized that lower fertility levels will impact sex ratios at birth due to a greater pressure placed on women to have less children while the demand for sons remains high. This issue was discussed at length in the literature review.

Population Growth: India's adverse sex ratio could reflect significant though sex biased improvements in life expectancy that result in rapid population growth in India. This hypothesis was tested in a study of India's declining sex ratios, examining the relationship between the sex ratio and the rate of increase in India's population between censuses; it was concluded that the two variables were strongly correlated with higher rates of population growth being associated with more masculine sex ratios (Mayer 1999). This variable is expressed as the rate of population change per district between the enumerations of 1991 and 2001.

Independent Variables: Geographic Factors

The final operational category includes geographic variables used to identify regional patterns of fertility and the sex ratio. This required subdividing India into five distinct regions, and entering four dummy variables, north, west, central and south into the regression model; categorical variables were made by assigning a "1" or "0" to the regions so their importance could be assessed. The dummies were entered into the analysis to (1) gauge regional variations and (2) circumvent any difficulties that might arise from using aggregate statistics that fall short of representing local circumstances (Smith 1973).

Regionalization of India

The regional approach to geographic research has long been viewed as "inherently geographic" and considered a focal point of all geographic work. Regional geography is concerned with the derivations and analysis of "the covariants of areal distributions on the surface of the earth" with regions being determined and divided into units according to the homogeneity of various geographic phenomena (Singh 1994, 26). A country such as India is far too complex for any overall generalization to be significant as it is too difficult to grasp it in its entirety, yet the task of regional division is a challenging and laborious one: "though regions exist, it by no means follows that [India] can be divided into well-marked areas" (Spate 1957; Singh 1994, 32). Early attempts to regionalize India often focused on physiographical features.

L. D. Stamp divided India into three natural regions primarily based on physiography and structure and secondly based on climate (Stamp 1967; Singh 1994). These regions are (1) the natural regions of the mountain wall, (2) the natural regions of the northern plain, and (3) the natural regions of the Indian plateau. Stamp's regionalization is still valued for its broad divisions of India, still, Kazi Ahmad introduced a forth division into Stamp's scheme that separated the coastal plains from the Indian plateau (Singh 1994). The National Geographic Society of India also divided the country into four regions based on geology, structure, relief, and physiography, in addition to the "positional factor," to give a rather clear-cut division of India that follows the various patterns of the landscape in general; these regions are (1) the Himalaya mountain region, (2) the great plains, (3) the peninsular uplands, and (4) the Indian coasts and islands (Singh 1994). None of these divisions took the human dimension of space into account.

Nevertheless, attempts have been made to divide India into cultural and demographic regions, mostly based on a perceived north-south divide:

> India has been divided into two very broad cultural and demographic zones. The northern and northwestern regions fall within the northern demographic and cultural zone, characterized by high fertility, high mortality, more masculine sex ratios, and low status of women. This zone has a wheat-based agrarian economy, a dowry system, exogamous marriage patterns, lower literacy and education levels of women, and seclusion of women. Conversely, the south is categorized by a rice-based agrarian economy and endogamous marriage patterns. Women's literacy

> and educational levels and status are higher than in the north, and the south has lower morality and fertility rates. (Bandyopadhyay 2003, 911-12; Dyson and Moore 1983; Sudha and Rajan 1999)

However, this crude dichotomy is faulty as the central, eastern, and western regions do not necessarily fit into the north and south categories (Bandyopadhyay 2003).

From a statistical analysis point of view, there is some justification to group states together as regions (Singh 1994), and while this, too, is not a fail-proof method, it is the method chosen for this study, though while grouping together states, physiographical, cultural, and demographic factors were taken into consideration. The following is the list of dummy regional variables to be run in the regression model and their corresponding states:

> *North:* North is for districts in Jammu and Kashmir, Himachal Pradesh, Punjab, Chandigarh, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, and Bihar.

> *West:* West is for districts in Gujarat, Daman and Diu, Dadra and Nagar Haveli, Maharashtra, and Goa.

> *South:* South is for districts in Andhra Pradesh, Karnataka, Lakshadweep, Kerala, Tamil Nadu, Pondicherry, and Andaman and Nicobar Islands.

> *Central:* Central is for districts in Orissa, Madhya Pradesh, and Chhattisgarh.

East: This region was not entered into the regression equation; it consists of districts in Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, Assam, West Bengal, and Jharkhand.

Figure 3. State Map of India

Table 1. Description of the Variables: Total Fertility Rate

VARIABLE NAME	VARIABLE DESCRIPTION	MEAN	S.D.
DEPENDENT VARIABLE			
TFR	Total Fertility Rate	930.182	47.388
INDEPENDENT VARIABLES			
	CULTURAL FACTORS		
SC	% of the population belonging to a scheduled caste	14.717	8.659
ST	% of the population belonging to a scheduled tribe	16.121	25.877
HIND	% of the population that is Hindu	75.803	25.455
MUSL	% of the population that is Muslim	11.775	15.475
CHRST	% of the population that is Christian	6.496	19.139
SIKH	% of the population that is Sikh	2.326	10.802
BUDD	% of the population that is Buddhist	1.591	7.019
JAIN	% of the population that is Jain	0.312	0.604
	SOCIO-ECONOMIC FACTORS		
FEMLIT	female literacy rate	53.519	15.461
FEMWK	female workforce participation rate	28.762	11.922
URBN	% of the population residing in an urban area	23.727	19.728
PRMHSE	% of the population residing in permanent housing; state-level proxy	50.662	18.064
ELCTR	% of the population with electricity as source of lighting; state-level proxy	57.010	24.653
	GEOGRAPHIC FACTORS		
NORTH	districts in Jammu & Kashmir, Himanchal Pradesh, Punjab, Chandigrah, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, and Bihar		
WEST	districts in Gujarat, Damman & Diu, Dadra & Nagar Haveli, Maharashtra, and Goa		
SOUTH	districts in Andhra Pradesh, Karnataka, Lakshadweep, Kerala, Tamil Nadu, Pondicherry, and Andaman & Nicobar Islands		
CNTRL	districts in Orissa, Madhya Pradesh, and Chhattisgarh		

Table 2. Description of the Variables: 0-6 Year Sex Ratio

VARIABLE NAME	VARIABLE DESCRIPTION	MEAN	S.D.
DEPENDENT VARIABLE			
SXRAT	Child Sex Ratio (0-6 year)	3.292	1.024
INDEPENDENT VARIABLES			
	CULTURAL FACTORS		
SC	% of the population belonging to a scheduled caste	14.717	8.659
ST	% of the population belonging to a scheduled tribe	16.121	25.877
HIND	% of the population that is Hindu	75.803	25.455
MUSL	% of the population that is Muslim	11.775	15.475
CHRST	% of the population that is Christian	6.496	19.139
SIKH	% of the population that is Sikh	2.326	10.802
BUDD	% of the population that is Buddhist	1.591	7.019
JAIN	% of the population that is Jain	0.312	0.604
	SOCIO-ECONOMIC FACTORS		
FEMLIT	female literacy rate	53.519	15.461
FEMWK	female workforce participation rate	28.762	11.922
URBN	% of the population residing in an urban area	23.727	19.728
PRMHSE	% of the population residing in permanent housing; state-level proxy	50.662	18.064
ELCTR	% of the population with electricity as source of lighting; state-level proxy	57.010	24.653
	DEMOGRAPHIC FACTORS		
POPCHG	% of the population change, 1991-2001	22.930	11.545
TFR	Total Fertility Rate	930.182	47.388
	GEOGRAPHIC FACTORS		
NORTH	districts in Jammu & Kashmir, Himanchal Pradesh, Punjab, Chandigrah, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, and Bihar		
WEST	districts in Gujarat, Damman & Diu, Dadra & Nagar Haveli, Maharashtra, and Goa		
SOUTH	districts in Andhra Pradesh, Karnataka, Lakshadweep, Kerala, Tamil Nadu, Pondicherry, and Andaman & Nicobar Islands		
CNTRL	districts in Orissa, Madhya Pradesh, and Chhattisgarh		

CHAPTER 6

RESULTS AND DISCUSSION

Eight regression models were constructed using the methodology outlined in Chapter 5: (1) variation in the total fertility rate excluding standard of living variables; (2) variation in the total fertility rate including standard of living variables; (3) variation in the total fertility rate excluding regional variables and standard of living variables; (4) variation in the total fertility rate excluding regional variables and including standard of living variables; (5) variation in the sex ratio at birth excluding standard of living variables; (6) variation in the sex ratio at birth including standard of living variables; (7) variation in the sex ratio at birth excluding regional variables and standard of living variables; and (8) variation in the sex ratio at birth excluding regional variables and including standard of living variables (standard of living variables are electricity as the source of lighting and permanent housing; data for these variables were only available at the state-level; regional dummy variables are north, west, south, and central).

Analysis of the Variation in the Total Fertility Rate

Total fertility rate and nine independent variables—female literacy rate, south, west, Sikh, Christian, female workforce participation, scheduled caste, north, and central—entered into SPSS for the first stepwise regression analysis; this model explained approximately 76 percent of the variation in the total fertility rate across India (Table 3). The first variable that entered into the equation was female literacy, explaining over half of the variance (53 percent). South, west, and Sikh were other significant variables.

The two standard of living variables were entered into SPSS for the second stepwise regression analysis. Twelve independent variables entered this equation—female literacy rate, south, electricity as the source of lighting, Christian, permanent housing, central, Sikh, north, female workforce participation, west, Jain, and urbanization—explaining approximately 76 percent of the variance (Table 4). Again, the first variable to enter the equation was female literacy, explaining over half of the variation. The overall explanatory power of the two models was the same.

To test the significance of the regional variables, regression analysis without the set of regional dummy variables was performed, both with and without the inclusion of the standard of living variables. The explanatory power of the model was weakened, as seen by the reduction in the R-square value, to 62 and 66 percent respectively (Tables 5 and 6).

Analysis of the Variation in the Sex Ratio at Birth

The sex ratio at birth and ten independent variables—Sikh, north, west, female literacy rate, Jain, scheduled tribe, population change, Muslim, south, and urban—entered into SPSS for the fifth stepwise regression analysis; this model explained approximately 60 percent of the variation in the sex ratio at birth across India (Table 7). The first variable that entered into the equation was Sikh, explaining 29 percent of the variance. Other significant variables were north, west, and female literacy.

The two standard of living variables were entered into SPSS for the sixth stepwise regression analysis; ten independent variables entered this equation—permanent housing, Sikh, south, scheduled tribe, electricity as the source for lighting, north, Muslim, female workforce participation, Buddhism, and west. This model had a slightly improved explanatory power than the previous model, explaining approximately 64 percent of the variance (Table 8). The first variable to enter the equation was permanent housing, explaining 29 percent of the variation, but it was eventually eliminated from the equation as variables added later made its contribution insignificant. Once again, Sikh remained the most significant variable.

For a second time, regression analysis without the set of dummy variables, and with and without the inclusion of the standard of living variables, was performed to test the significance of the regional variables, and again region was found to be important. Without the regional variables, the explanatory power of both models dropped to 50 and 57 percent (Tables 9 and 10).

Discussion of the Variation in the Total Fertility Rate

Female literacy, and consequently female education, was shown to have the greatest influence on fertility levels, explaining half of the variation in total fertility rates across India. This was not unforeseen, given the literature supporting the role of female education in fertility decline. According to Pearson’s correlation matrix (Table 11), the correlation between the total fertility rate and the female literacy rate is negative and strong (r = -0.73), implying that as literacy rates rise, fertility levels decline.

Female literacy is widespread in south India where four of the nine districts with rates above 90 percent are in Kerala: Kottayam, Pathanamthitta, Alappuzzha, and Ernakulam; it is noted that fertility is well under the replacement level in these districts, averaging 1.5. However, some of the districts with the highest female literacy rates, including the first and third highest rates, are in the eastern state of Mizoram; these districts have much higher levels of fertility, averaging 3.4. Upon closer inspection, these districts also have the highest levels of Christianity—over 90 percent—and as India's Christian population is considered more affluent than the average population, this could explain the high literacy rates.

Other variables having significant correlations with fertility are south (r = -0.51), north (r = 0.42), and urbanization (r = -0.41). The urbanization variable only entered the regression equation when regional and standard of living variables were omitted, suggesting there was overlap in the explanatory power of these variables; and even when it did enter the equation, it did not explain much of the variance.   Nonetheless, all nine completely urban districts—and major urban centers Mumbai, Kolkata, New Delhi, and Bangalore—have fertility levels ranging from 1.3 to 2.0, well below replacement values; rural districts have the highest fertility levels. Region did explain much of the variance, concurring with results from the previously mentioned study that reconstructed India's fertility transition: "spatial variations of fertility in India are far from random" and fertility change progresses through diffusion processes at the micro-level (Guilmoto and Rajan 2001, 713). What was unexpected was the lack of correlation between fertility and female workforce participation (r = 0.05). Female workforce participation did enter the regression model, but its explanatory power was negligible.

Discussion of the Variation in the Sex Ratio

The percentage of the population per district that is Sikh was shown to have the greatest impact on the sex ratio at birth, explaining 29 percent of the variance. The correlation between the sex ratio at birth and the Sikh population (Table 12) is strong (r = -0.53), indicating that regions with large Sikh populations have relatively fewer females being born. Across much of India, Sikhs are a minority group; most of the Sikh population is concentrated in Punjab where seventeen districts range from 37 to 86 percent Sikh. Other states having districts over 10 percent Sikh are Haryana, Rajasthan, and Chandigarh. Including Punjab, these are all states in north India with extremely masculine child sex ratios. Punjab has greater disparities in the child sex ratio than any other state, with ratios ranging from 766—meaning 766 females born for every 1000 males born—to 822. The Punjab district of Fatehgarh Sahib, with its child sex ratio of 766, has the lowest rate of females being born in the country. But Punjab is not in the heart of traditional India, nor is it in one of the less developed regions despite it not being overly urbanized. Punjab has a notably wealthy rural farm population, beneficiaries of the "Green Revolution," and at the state-level it has higher standards of living than much of India, with some of the highest rates of the population living in permanent housing and having electricity, even higher than in the south. The percentage of the population living in permanent housing and having electricity as the source of lighting has significant negative correlations with the sex ratio at birth (r = -0.54 and r = -0.32 respectively), suggesting that as standard of living increases, the female to male ratio decreases. This is unfortunate though not exactly unexpected: it follows with the belief that regions with higher standards of living provide greater access to prenatal sex detection and abortion facilities.

The percentages of the population belonging to a scheduled caste or a scheduled tribe have moderate correlations with the sex ratio at birth (r = -0.32 and r = -0.40). Scheduled caste did not enter into the regression equation, but scheduled tribe did with slight explanatory power. Tribal populations have different kinship patterns than those found in much of India, therefore it is possible that son preference is not as prevalent in this population. Due to the extreme poverty of tribal populations, women are valued for their economic contributions to the family unit; also, it is likely that these populations do not have as much access to costly sex detection technologies.

Female literacy has a negative correlation with the sex ratio at birth (r = -0.14); this correlation is small but implies that higher rates of female literacy indicate better awareness of sex-identification technologies, and thus, a higher usage of these technologies by educated women. It entered into a few of the regression equations, most notably when standard of living variables were excluded. Female workforce participation has a small positive correlation with the sex ratio at birth (r = 0.26) but not much clout in the regression equation; still, this finding suggests that increasing women's economic value increases their prenatal survival chances.

Regional location exerts a strong influence on the sex ratio at birth, explaining much of its variance. In the fifth stepwise regression model (Table 7), Sikh, north, and west combined to explain 48 percent of the variation in the sex ratio at birth. North has a strong negative correlation with the sex ratio (r = -0.47), reflecting this region's traditional son preference and the correspondingly high masculinity of its population. By far, the greatest disparity in the sex ratio at birth is in north India, followed by districts in the western states Gujarat and Maharashtra. However, only ten of the 593 districts analyzed in this study have unbiased sex ratios. Kerala—the state generally regarded as India's most developed and where women have the highest status—does not have a single district with an unbiased sex ratio at birth, and while it ranks better than most states, the sex ratio ranges from 954 to 969. So while there continues to be a north-south disparity in the sex ratio at birth, all of India is at risk for an increasingly masculine child population. This brings up a concern: sex identification technologies, such as the ultra-sound scan, are gradually diffusing to areas where preference for sons had beforehand been less prevalent. With India's present social norms, the propagation of this technology has plenty of room to grow before it wears out its potential market.

What about arguments that fertility decline is supplemented by excess female mortality? Is there a correlation between the sex ratio at birth and fertility levels? Surprisingly, the correlation between these variables is quite negligible (r = 0.05); fertility does not enter into any of the regression equations and, contrary to the literature, appears to have no explanatory power over the sex ratio.

Table 3. Stepwise Regression Results for TFR, Excluding SOL

Model	R	R Square	Adjusted R Square
1	0.727	0.528	0.528
2	0.801	0.641	0.64
3	0.820	0.673	0.671
4	0.833	0.695	0.693
5	0.839	0.704	0.702
6	0.847	0.717	0.715
7	0.851	0.723	0.72
8	0.853	0.727	0.723
9	0.86	0.739	0.735
10	0.859	0.738	0.734

1. Predictors: (Constant), FEMLIT
2. Predictors: (Constant), FEMLIT, SOUTH
3. Predictors: (Constant), FEMLIT, SOUTH, WEST
4. Predictors: (Constant), FEMLIT, SOUTH, WEST, SIKH
5. Predictors: (Constant), FEMLIT, SOUTH, WEST, SIKH, CHRST
6. Predictors: (Constant), FEMLIT, SOUTH, WEST, SIKH, CHRST, FEMWK
7. Predictors: (Constant), FEMLIT, SOUTH, WEST, SIKH, CHRST, FEMWK, SC
8. Predictors: (Constant), FEMLIT, SOUTH, WEST, SIKH, CHRST, FEMWK, SC, NORTH
9. Predictors: (Constant), FEMLIT, SOUTH, WEST, SIKH, CHRST, FEMWK, SC, NORTH, CNTRL
10. Predictors: (Constant), FEMLIT, SOUTH, SIKH, CHRST, FEMWK, SC, NORTH, CNTRL

Table 4. Stepwise Regression Results for TFR, Including SOL

Model	R	R Square	Adjusted R Square
1	0.727	0.528	0.528
2	0.801	0.641	0.640
3	0.825	0.681	0.679
4	0.835	0.697	0.695
5	0.846	0.715	0.713
6	0.859	0.738	0.736
7	0.865	0.749	0.746
8	0.87	0.756	0.753
9	0.872	0.760	0.756
10	0.873	0.761	0.757
11	0.874	0.764	0.759
12	0.875	0.766	0.761
13	0.875	0.765	0.760

1. Predictors: (Constant), FEMLIT
2. Predictors: (Constant), FEMLIT, SOUTH
3. Predictors: (Constant), FEMLIT, SOUTH, ELCTR
4. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST
5. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE
6. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL
7. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH
8. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH, NORTH
9. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH, NORTH, FEMWK
10. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH, NORTH, FEMWK, WEST
11. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH, NORTH, FEMWK, WEST, JAIN
12. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH, NORTH, FEMWK, WEST, JAIN, URBN
13.. Predictors: (Constant), FEMLIT, SOUTH, ELCTR, CHRST, PRMHSE, CNTRL, SIKH, FEMWK, WEST, JAIN, URBN

Table 5. Stepwise Regression Results for TFR, Excluding Region and SOL

Model	R	R Square	Adjusted R Square
1	0.727	0.528	0.528
2	0.745	0.556	0.554
3	0.764	0.584	0.582
4	0.769	0.592	0.589
5	0.774	0.599	0.596
6	0.781	0.610	0.606
7	0.785	0.616	0.611
8	0.791	0.625	0.620

1. Predictors: (Constant), FEMLIT
2. Predictors: (Constant), FEMLIT, CHRST
3. Predictors: (Constant), FEMLIT, CHRST, FEMWK
4. Predictors: (Constant), FEMLIT, CHRST, FEMWK, SIKH
5. Predictors: (Constant), FEMLIT, CHRST, FEMWK, SIKH, URBN
6. Predictors: (Constant), FEMLIT, CHRST, FEMWK, SIKH, URBN, JAIN
7. Predictors: (Constant), FEMLIT, CHRST, FEMWK, SIKH, URBN, JAIN, SC
8. Predictors: (Constant), FEMLIT, CHRST, FEMWK, SIKH, URBN, JAIN, SC, ST

Table 6. Stepwise Regression Results for TFR, Excuding Region and Including SOL

Model	R	R Square	Adjusted R Square
1	0.727	0.528	0.528
2	0.778	0.605	0.604
3	0.791	0.625	0.623
4	0.803	0.644	0.642
5	0.812	0.659	0.656
6	0.813	0.661	0.658
7	0.815	0.664	0.660

1. Predictors: (Constant), FEMLIT
2. Predictors: (Constant), FEMLIT, ELCTR
3. Predictors: (Constant), FEMLIT, ELCTR, CHRST
4. Predictors: (Constant), FEMLIT, ELCTR, CHRST, PRMHSE
5. Predictors: (Constant), FEMLIT, ELCTR, CHRST, PRMHSE, JAIN
6. Predictors: (Constant), FEMLIT, ELCTR, CHRST, PRMHSE, JAIN, ST
7. Predictors: (Constant), FEMLIT, ELCTR, CHRST, PRMHSE, JAIN, ST, SC

Table 7. Stepwise Regression Results for the Child Sex Ratio, Excluding SOL

Model	R	R Square	Adjusted R Square
1	0.534	0.285	0.284
2	0.633	0.400	0.398
3	0.695	0.483	0.481
4	0.727	0.529	0.525
5	0.748	0.560	0.556
6	0.758	0.574	0.570
7	0.763	0.582	0.577
8	0.768	0.590	0.585
9	0.773	0.597	0.591
10	0.772	0.597	0.591
11	0.774	0.600	0.594
12	0.776	0.602	0.596

1. Predictors: (Constant), SIKH
2. Predictors: (Constant), SIKH, NORTH
3. Predictors: (Constant), SIKH, NORTH, WEST
4. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT
5. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, HIND
6. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, HIND, JAIN
7. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, HIND, JAIN, ST
8. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, HIND, JAIN, ST, POPCHG
9. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, HIND, JAIN, ST, POPCHG, MUSL
10. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, JAIN, ST, POPCHG, MUSL
11. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, JAIN, ST, POPCHG, MUSL, SOUTH
12. Predictors: (Constant), SIKH, NORTH, WEST, FEMLIT, JAIN, ST, POPCHG, MUSL, SOUTH, URBN

Table 8. Stepwise Regression Results for the Child Sex Ratio, Including SOL

Model	R	R Square	Adjusted R Square
1	0.536	0.287	0.286
2	0.647	0.419	0.417
3	0.695	0.483	0.480
4	0.740	0.547	0.544
5	0.759	0.576	0.572
6	0.769	0.592	0.588
7	0.781	0.609	0.605
8	0.780	0.608	0.604
9	0.794	0.630	0.626
10	0.798	0.636	0.632
11	0.801	0.642	0.636

1. Predictors: (Constant), PRMHSE
2. Predictors: (Constant), PRMHSE, SIKH
3. Predictors: (Constant), PRMHSE, SIKH, SOUTH
4. Predictors: (Constant), PRMHSE, SIKH, SOUTH, ST
5. Predictors: (Constant), PRMHSE, SIKH, SOUTH, ST, ELCTR
6. Predictors: (Constant), PRMHSE, SIKH, SOUTH, ST, ELCTR, NORTH
7. Predictors: (Constant), PRMHSE, SIKH, SOUTH, ST, ELCTR, NORTH, MUSL
8. Predictors: (Constant), SIKH, SOUTH, ST, ELCTR, NORTH, MUSL
9. Predictors: (Constant), SIKH, SOUTH, ST, ELCTR, NORTH, MUSL, FEMWK
10. Predictors: (Constant), SIKH, SOUTH, ST, ELCTR, NORTH, MUSL, FEMWK, BUDD
11. Predictors: (Constant), SIKH, SOUTH, ST, ELCTR, NORTH, MUSL, FEMWK, BUDD, WEST

Table 9. Stepwise Regression Results: Child Sex Ratio, Excluding Region and SOL

Model	R	R Square	Adjusted R Square
1.000	0.534(a)	0.285	0.284
2.000	0.630(b)	0.396	0.394
3.000	0.659(c)	0.434	0.431
4.000	0.676(d)	0.457	0.453
5.000	0.688(e)	0.474	0.469
6.000	0.695(f)	0.483	0.477
7.000	0.704(g)	0.496	0.490

1. Predictors: (Constant), SIKH
2. Predictors: (Constant), SIKH, ST
3. Predictors: (Constant), SIKH, ST, JAIN
4. Predictors: (Constant), SIKH, ST, JAIN, POPCHG
5. Predictors: (Constant), SIKH, ST, JAIN, POPCHG, MUSL
6. Predictors: (Constant), SIKH, ST, JAIN, POPCHG, MUSL, FEMLIT
7. Predictors: (Constant), SIKH, ST, JAIN, POPCHG, MUSL, FEMLIT, TFR

Table 10. Regression Results: Child Sex Ratio, Excluding Region and Including SOL

Model	R	R Square	Adjusted R Square
1	0.536	0.287	0.286
2	0.647	0.419	0.417
3	0.684	0.467	0.465
4	0.706	0.498	0.495
5	0.719	0.517	0.513
6	0.728	0.529	0.524
7	0.731	0.534	0.528
8	0.734	0.538	0.532
9	0.746	0.556	0.549
10	0.752	0.566	0.559

1. Predictors: (Constant), PRMHSE
2. Predictors: (Constant), PRMHSE, SIKH
3. Predictors: (Constant), PRMHSE, SIKH, ST
4. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG
5. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG, MUSL
6. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG, MUSL, JAIN
7. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG, MUSL, JAIN, FEMWRK
8. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG, MUSL, JAIN, FEMWRK, ELCTR
9. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG, MUSL, JAIN, FEMWRK, ELCTR, TFR
10. Predictors: (Constant), PRMHSE, SIKH, ST, POPCHG, MUSL, JAIN, FEMWRK, ELCTR, TFR, FEMLIT

Table 11. Pearson's Correlation Matrix: Total Fertility Rate

	TFR	SC	ST	HIND	MUSL	CHRST	SIKH	BUDD	JAIN
TFR	1.000	0.043	0.097	-0.019	0.144	-0.031	-0.146	-0.035	-0.026
SC	0.043	1.000	-0.609	0.404	-0.108	-0.449	0.326	-0.193	-0.041
ST	0.097	-0.609	1.000	-0.510	-0.173	0.679	-0.125	0.184	-0.103
HIND	-0.019	0.404	-0.510	1.000	-0.384	-0.657	-0.282	-0.232	0.174
MUSL	0.144	-0.108	-0.173	-0.384	1.000	-0.169	-0.115	-0.076	-0.058
CHRST	-0.031	-0.449	0.679	-0.657	-0.169	1.000	-0.064	0.017	-0.140
SIKH	-0.146	0.326	-0.125	-0.282	-0.115	-0.064	1.000	-0.039	-0.046
BUDD	-0.035	-0.193	0.184	-0.232	-0.076	0.017	-0.039	1.000	-0.036
JAIN	-0.026	-0.041	-0.103	0.174	-0.058	-0.140	-0.046	-0.036	1.000
FEMLIT	-0.727	-0.075	-0.001	-0.089	-0.182	0.261	0.087	0.003	0.081
FEMWRK	-0.049	-0.231	0.493	-0.001	-0.372	0.248	-0.134	0.192	-0.017
URBN	-0.407	-0.022	-0.190	0.002	0.007	-0.022	0.088	-0.084	0.356
PRMHSE	-0.221	0.303	-0.367	0.093	-0.018	-0.286	0.366	0.022	0.185
ELCTR	-0.575	-0.050	0.016	-0.082	-0.137	0.046	0.264	0.134	0.240
NORTH	0.416	0.407	-0.348	0.053	0.161	-0.255	0.264	-0.075	-0.025
SOUTH	-0.513	0.058	-0.183	0.095	-0.005	0.003	-0.096	-0.088	-0.088
WEST	-0.220	-0.247	-0.022	0.117	-0.064	-0.090	-0.072	0.113	0.286
CNTRL	0.096	0.003	0.156	0.285	-0.218	-0.108	-0.085	-0.084	0.103

(cont.)

	FEMLIT	FEMWK	URBN	PRMSHE	ELCTR	NORTH	SOUTH	WEST	CNTRL
TFR	-0.727	-0.049	-0.407	-0.221	-0.575	0.416	-0.513	-0.220	0.096
SC	-0.075	-0.231	-0.022	0.303	-0.050	0.407	0.058	-0.247	0.003
ST	-0.001	0.493	-0.190	-0.367	0.016	-0.348	-0.183	-0.022	0.156
HIND	-0.089	-0.001	0.002	0.093	-0.082	0.053	0.095	0.117	0.285
MUSL	-0.182	-0.372	0.007	-0.018	-0.137	0.161	-0.005	-0.064	-0.218
CHRST	0.261	0.248	-0.022	-0.286	0.046	-0.255	0.003	-0.090	-0.108
SIKH	0.087	-0.134	0.088	0.366	0.264	0.264	-0.096	-0.072	-0.085
BUDD	0.003	0.192	-0.084	0.022	0.134	-0.075	-0.088	0.113	-0.084
JAIN	0.081	-0.017	0.356	0.185	0.240	-0.025	-0.088	0.286	0.103
FEMLIT	1.000	-0.092	0.491	0.175	0.452	-0.340	0.259	0.164	0.034
FEMWRK	-0.092	1.000	-0.345	-0.097	0.299	-0.301	0.060	0.103	0.163
URBN	0.491	-0.345	1.000	0.348	0.381	-0.063	0.195	0.130	-0.100
PRMHSE	0.175	-0.097	0.348	1.000	0.578	0.439	0.182	0.220	-0.390
ELCTR	0.452	0.299	0.381	0.578	1.000	-0.184	0.334	0.324	-0.074
NORTH	-0.340	-0.301	-0.063	0.439	-0.184	1.000	-0.353	-0.273	-0.332
SOUTH	0.259	0.060	0.195	0.182	0.334	-0.353	1.000	-0.159	-0.193
WEST	0.164	0.103	0.130	0.220	0.324	-0.273	-0.159	1.000	-0.149
CNTRL	0.034	0.163	-0.100	-0.390	-0.074	-0.332	-0.193	-0.149	1.000

Table 12. Pearson's Correlation Matrix: The 0-6 Child Sex Ratio

	SXRAT	SC	ST	HIND	MUSL	CHRST	SIKH	BUDD	JAIN	FEMLIT
SXRAT	1.000	-0.392	0.398	-0.095	0.118	0.225	-0.534	0.094	-0.204	-0.135
SC	-0.392	1.000	-0.609	0.404	-0.108	-0.449	0.326	-0.193	-0.041	-0.075
ST	0.398	-0.609	1.000	-0.510	-0.173	0.679	-0.125	0.184	-0.103	-0.001
HIND	-0.095	0.404	-0.510	1.000	-0.384	-0.657	-0.282	-0.232	0.174	-0.089
MUSL	0.118	-0.108	-0.173	-0.384	1.000	-0.169	-0.115	-0.076	-0.058	-0.182
CHRST	0.225	-0.449	0.679	-0.657	-0.169	1.000	-0.064	0.017	-0.140	0.261
SIKH	-0.534	0.326	-0.125	-0.282	-0.115	-0.064	1.000	-0.039	-0.046	0.087
BUDD	0.094	-0.193	0.184	-0.232	-0.076	0.017	-0.039	1.000	-0.036	0.003
JAIN	-0.204	-0.041	-0.103	0.174	-0.058	-0.140	-0.046	-0.036	1.000	0.081
FEMLIT	-0.135	-0.075	-0.001	-0.089	-0.182	0.261	0.087	0.003	0.081	1.000
FEMWK	0.257	-0.231	0.493	-0.001	-0.372	0.248	-0.134	0.192	-0.017	-0.092
URBN	-0.253	-0.022	-0.190	0.002	0.007	-0.022	0.088	-0.084	0.356	0.491
PRMHSE	-0.536	0.303	-0.367	0.093	-0.018	-0.286	0.366	0.022	0.185	0.175
ELCTR	-0.319	-0.050	0.016	-0.082	-0.137	0.046	0.264	0.134	0.240	0.452
NORTH	-0.468	0.407	-0.348	0.053	0.161	-0.255	0.264	-0.075	-0.025	-0.340
SOUTH	0.211	0.058	-0.183	0.095	-0.005	0.003	-0.096	-0.088	-0.088	0.259
WEST	-0.149	-0.247	-0.022	0.117	-0.064	-0.090	-0.072	0.113	0.286	0.164
CNTRL	0.163	0.003	0.156	0.285	-0.218	-0.108	-0.085	-0.084	0.103	0.034
TFR	0.050	0.043	0.097	-0.019	0.144	-0.031	-0.146	-0.035	-0.026	-0.727
POPCHG	-0.073	-0.177	0.246	-0.274	0.083	0.317	-0.024	0.015	0.085	-0.200

(cont.)

	FEMWK	URBN	PRMHSE	ELCTR	NORTH	SOUTH	WEST	CNTRL	TFR	POPCHG
SXRAT	0.257	-0.253	-0.536	-0.319	-0.468	0.211	-0.149	0.163	0.050	-0.073
SC	-0.231	-0.022	0.303	-0.050	0.407	0.058	-0.247	0.003	0.043	-0.177
ST	0.493	-0.190	-0.367	0.016	-0.348	-0.183	-0.022	0.156	0.097	0.246
HIND	-0.001	0.002	0.093	-0.082	0.053	0.095	0.117	0.285	-0.019	-0.274
MUSL	-0.372	0.007	-0.018	-0.137	0.161	-0.005	-0.064	-0.218	0.144	0.083
CHRST	0.248	-0.022	-0.286	0.046	-0.255	0.003	-0.090	-0.108	-0.031	0.317
SIKH	-0.134	0.088	0.366	0.264	0.264	-0.096	-0.072	-0.085	-0.146	-0.024
BUDD	0.192	-0.084	0.022	0.134	-0.075	-0.088	0.113	-0.084	-0.035	0.015
JAIN	-0.017	0.356	0.185	0.240	-0.025	-0.088	0.286	0.103	-0.026	0.085
FEMLIT	-0.092	0.491	0.175	0.452	-0.340	0.259	0.164	0.034	-0.727	-0.200
FEMWK	1.000	-0.345	-0.097	0.299	-0.301	0.060	0.103	0.163	-0.049	-0.119
URBN	-0.345	1.000	0.348	0.381	-0.063	0.195	0.130	-0.100	-0.407	0.086
PRMHSE	-0.097	0.348	1.000	0.578	0.439	0.182	0.220	-0.390	-0.221	-0.099
ELCTR	0.299	0.381	0.578	1.000	-0.184	0.334	0.324	-0.074	-0.575	-0.081
NORTH	-0.301	-0.063	0.439	-0.184	1.000	-0.353	-0.273	-0.332	0.416	0.232
SOUTH	0.060	0.195	0.182	0.334	-0.353	1.000	-0.159	-0.193	-0.513	-0.364
WEST	0.103	0.130	0.220	0.324	-0.273	-0.159	1.000	-0.149	-0.220	-0.035
CNTRL	0.163	-0.100	-0.390	-0.074	-0.332	-0.193	-0.149	1.000	0.096	-0.090
TFR	-0.049	-0.407	-0.221	-0.575	0.416	-0.513	-0.220	0.096	1.000	0.396
POPCHG	-0.119	0.086	-0.099	-0.081	0.232	-0.364	-0.035	-0.090	0.396	1.000

CHAPTER 7

CONCLUSIONS

An important finding of this study is that region matters when explaining the regional variation in fertility and the sex ratio: regression models had more explanatory power with the inclusion of regional variables. By comparing the variations in fertility and the sex ratio at birth, local circumstances revealed gendered interpretations of fertility and mortality in the spatial organization of Indian society.

The increasing disparity in the male to female sex ratio is an unfortunate element of India's demographic profile and is both longstanding and continuous. Cultural factors such as the Sikh population are important in explaining its regional variation, implying that son preference is a deeply rooted cultural tradition. However, another important finding of this study is the lack of correlation between fertility levels and the sex ratio at birth, although this could change with the inclusion of a temporal scale, i.e. does fertility decline over time impact regional differentials in the sex ratio at birth?

Fertility transition is well underway in India, though it has occurred in different regions and at varying speeds across the country. This study attempted to explain the spatial differentials in this transition—how is it accomplished? Ansley Coale (1973) believed that three preconditions lead to fertility decline: (1) the acceptance of calculated choice as a valid element in marital fertility; (2) the perception of advantages resulting from fertility reduction; and (3) the knowledge and mastery of effective techniques of birth control. How is India meeting these conditions? First, one must know who is in control of reproduction, because if a woman is controlled by her husband or other family members, she is not (Weeks 2005). Women's status is known to have a great impact on reducing family size, and for this study, female literacy was the best overall predictor of the spatial variation in fertility: educated women are more knowledgeable of effective birth control techniques and more likely to be in control of their reproductive behavior. Then again, educated women are more knowledgeable of sex-identification technology and more apt to use it to gain their desired number of sons. Still, women who choose to use these techniques are not to blame for India's masculine sex ratios as they are not always the decision-makers and are often victims of discrimination themselves.

Evidence suggests that daughter discrimination continues to occur across a wide array of environments, contrary to the general belief that economic development and societal modernization reduces the bias in favor of sons. However, excess female mortality is not merely a cultural issue: "it has a lot to do with the globalization of technology. It's about the commodification of choices" (Baldauf 2006), and as India becomes more involved with the global community, families are likely to react to the uncertainty of modernization by turning to traditional norms such as son preference and the elimination of daughters.

The implications of this study have applied significance to a number of disciplines—geography, sociology, economics, demography, and women's studies—and also advance the field of population geography as, currently, issues embracing fertility and mortality are largely ignored. It allows population geography to embrace critical geographies by providing an empirical basis for more critical feminist research to take place, i.e. what are the spatial differentials in women's experiences in India, what are the proximate determinants of women's agency, what are the underlying factors behind female education and employment? Aggregate data can only go so far in answering these questions; qualitative research at the micro-level is the next step.

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VITA

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