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INDIA'S 'MISSING WOMEN' AND MEN'S SEXUAL RISK BEHAVIOR

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Abstract

Although scholars and policymakers have long been concerned with the “missing women” of India, little rigorous research has examined the consequences of India’s sex ratio imbalance for young men’s sexual risk behavior and reproductive health. We use data from the third wave of India’s 2005–2006 National Family and Health Survey to examine the influence of the community female-to-male sex ratio at ages 10 to 39 on men’s likelihood of marrying early in life, of engaging in premarital, multi-partnered, and commercial sex, and of contracting a sexually-transmitted disease (STD). We estimate logistic regression models that control for respondents’ demographic and socioeconomic status and that adjust for the clustering of observations within communities. Net of the effects of other characteristics, the female-to-male sex ratio is positively and significantly associated with the likelihood that men marry prior to age 18 and inversely and significantly associated with the odds that men have had intercourse with a commercial sex worker. However, no significant net associations are observed between the sex ratio and the other outcomes. Education, wealth, religious affiliation, caste, and geographic region emerge as significant predictors of Indian men’s sexual risk behaviors.

Keywords

sex ratio; sexual behavior; India; marriage; commercial sex; STD

The population of India has long been characterized by a numerical deficit of females (Agnihotri 2000; Guillot 2002), and for at least some age groups this sex ratio imbalance has grown over recent decades (Garg and Nath 2008; Guilmoto 2008). Although the reported sex ratio at birth may have improved (i.e., become less masculine) slightly in recent years (Haub 2011; Sharma and Haub 2008), the most recent 2011 Indian census surprised many observers by revealing a growing deficit of female children (Census of India 2011). Deterioration in the child sex ratio is generally attributed to widespread use of sex-selective abortion technology in prior years (Arnold, Kishor, and Roy 2002; Hvistendahl 2011). A

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voluminous literature has documented levels, trends, and differentials in India's population sex ratio and has explored the proximate and distal causes of India's "missing women" (Sen 1992). Yet, we know little about the *consequences* of India's imbalance in the numbers of women and men for critical family, demographic, and health-related behaviors.

The effects of the most recent imbalances in India's child sex ratio will not be felt fully at the national level for another decade or two when these cohorts reach young adulthood. However, it is possible to exploit the substantial inter-community variation in India's numerical deficit of females to examine how contemporary variation in India's sex ratio influences men's family and health-related behaviors. Exploring how contemporary imbalances in the sex ratio across communities are associated with these behaviors is not only important in its own right, but may also provide clues as to how the looming imbalance in India's adult sex ratios will affect family and health behaviors in the future.

This paper uses data from India's 2005–2006 National Family and Health Survey (NFHS-3) to examine the association between community-level sex ratios and various dimensions of men's family and sexual behavior. Our outcome variables include age at marriage, the likelihood of engaging in premarital, multi-partnered, and commercial sex, and a self-reported measure of having a sexually-transmitted disease. Our focal explanatory variable is the community-level sex ratio for the adolescent and young adult population. Our models control for several individual-level and geographic characteristics that could potentially confound an effect of the community sex ratio on men's marital timing and sexual behavior.

BACKGROUND

Like some other Asian countries (Croll 2000; Das Gupta et al. 2003), India has been experiencing fairly dramatic changes in its relative numbers of women and men (Agnihotri 2000; Griffiths, Matthews, and Hinde 2000; Garg and Nath 2008; Guilmoto 2007; Mayer 1999). Although the overall trend in the masculinization of India's total population has been somewhat discontinuous (Guillot 2002) and may have abated somewhat between the 2001 and 2011 censuses (Census of India 2011), increases in the number of males per females have been especially pronounced at the younger ages. Guilmoto (2008) reports an increase in the childhood (ages 0 to 4) sex ratio of 98 boys per 100 girls in 1971 to over 107 boys per 100 girls in 2001. By 2011, there were 109.4 boys per 100 girls (ages 0 to 6) recorded in the India census (Census of India 2011). The sex ratio at birth, currently about 111 at the national level (Haub 2011), also has been abnormally high in some Indian states (Arnold, Kishor, and Roy 2002). Both the level of, and recent changes in, the Indian population sex ratio exhibit sharp regional variation (Dyson 2001). For example, the sex ratio at birth (boys per 100 girls) in Punjab *circa* 2000 was over 129, and was almost as high in several other states (Sharma and Haub 2008). And across the Indian states, the current sex ratio for the child population (ages 0–6) ranges widely. For example, there are currently 120.5 boys per 100 girls in the northern state of Haryana compared to 104.3 in the southern state of Kerala (Census of India 2011). The "missing" girls and women of India reflected in these figures constitute a critical concern for scholars and policymakers alike (Bandyopadhyay 2003; Bhat and Sharma 2006; George 2002; Klasen and Wink 2002; 2003; Sen 1992).

The vast bulk of research on sex ratio imbalances in India as well as elsewhere in the developing world has been devoted to documenting levels and trends in the numerical deficit of females and in identifying the proximate and distal causes of this imbalance. For the country as a whole, the most proximate causes of imbalances in the *adult* sex ratio are, of course, imbalanced sex ratios at birth and during childhood in prior years. As cohorts age, sex ratio imbalances in childhood create sex ratio imbalances in adulthood. In India, a longstanding preference for sons (Clark 2000; Das Gupta et al. 2003; Pande and Astone

2007) and, more recently, sex-selective abortion technology (Abrejo et al. 2009; Arnold, Kishor, and Roy 2002; George 2002; Jha et al. 2006) help to explain much of the imbalance in the sex ratio at birth. Excess female mortality in the ages of 2–5 is particularly acute (Oster 2009). In turn, the most important proximate causes of excess female mortality during early childhood are sex differences in health care, including immunization (Boorah 2004; Pande 2003) and hospitalization (Asfaw et al. 2010), and a gender bias in nutrition and feeding (Chen et al. 1981; Mishra, Roy and Retherford 2004). More distally, sex ratio imbalances at birth and during childhood are rooted in a patriarchal social structure that privileges the familial and economic contributions of boys and men over that of girls and women (Das Gupta 1987; Malhotra et al. 1995). Across sub-regions of India, higher levels of female education and labor force participation are associated with lower levels of excess female mortality (Murthi et al. 1995) and milder imbalances in the sex ratio (Agnihotri, Palmer-Jones, and Parikh 2002).

Although little research has addressed the consequences of India's sex ratio imbalances, several studies have explored the issue elsewhere in the developing world, particularly China. Hudson and Den Boer (2002 China. Hudson and Den Boer (2004) suggest that the surplus of males in China and other Asian societies will foster militaristic and authoritarian regimes that threaten U.S. national security and global political stability. Other observers suggest that in China the growing population of "surplus males" will contribute substantially to the spread of HIV and other sexually transmitted infections (STIs) and diseases (STDs). For example, Poston and Glover (2005) predict a dramatic increase in commercial sex in so-called "bachelor ghettos," along with a marked spread of HIV/AIDS that will reach epidemic proportions. Somewhat similarly, Eberstein and Sharygin (2009) suggest that China's deficit of women will reduce men's marriage rates and increase rates of prostitution and sexually-transmitted infections (see also South and Trent 2010; Tucker et al. 2005). Edlund et al. (2007) find that China's increasingly masculine sex ratio was partially responsible for increases in property and violent crime rates between 1988 and 2004. Other researchers have uncovered similar linkages between the sex ratio and violent crime in India (Dreze and Khera 2000; Oldenburg 1992; Mayer et al. 2008).

HYPOTHESES

Drawing on prior discussions of the impact of imbalanced sex ratios on marital timing (e.g., Ebenstein and Sharygin 2009; Lloyd and South 1996), it is plausible to hypothesize that a numerical deficit of women will avert or delay men's entry into marriage. With few possible mates available to them in their local marriage market, some men may be forced to postpone marriage, perhaps indefinitely. To be sure, as Edlund (1999) observes, men can adjust to a sex ratio imbalance by marrying outside of their preferred pool of mates, for example, by marrying (much) younger women or women of a different caste or social class. But enlarging the pool of potential mates will also serve to restrict the options of men farther down the hierarchy of desirable husbands, and thus at some point there are simply too few women available for all men to be able to marry.

Imbalances in the numbers of adult men and women are also likely to affect other dimensions of men's family-related and sexual behaviors but in ways that are theoretically indeterminate. Indeed, a numerical undersupply of women in the local "marriage market" could either increase or decrease men's likelihood of engaging in risky sexual behaviors (South and Trent 2010). On the one hand, exposure to relatively few potential marital partners is likely to delay men's transition to first marriage, thus increasing the duration of time they are at risk of engaging in premarital intercourse with multiple (different) partners. Early marriage likely serves as a protective barrier against these and other risky sexual behaviors. Moreover, a deficit of available sexual partners may encourage men to satisfy

their sexual desires by seeking the services of commercial sex workers, which itself is a risk factor for sexually-transmitted infections and diseases, including HIV/AIDS (Chandrasekaran et al. 2006). Imbalanced sex ratios could also affect men's sexual health by influencing women's sexual risk behaviors. For example, Trent and South (2012) find that, in China, women are more likely to test positive for a sexually-transmitted infection when there is a relative abundance of men (and hence a relative deficit of women) in their local marriage market. If these infections are subsequently transmitted to their male partners, then a deficit of women could increase men's risk of contracting an STD by increasing women's STD risk. This line of reasoning implies that a numerical deficit of young women in men's local community will have generally undesirable repercussions for men's sexual and reproductive health.

On the other hand, a numerical deficit of women could also constrain men's sexual risk behavior by limiting the number of partners with whom they can form sexual relationships. Although men may be less likely to marry, or forced to marry later in life, when women are numerically scarce, with few partners to choose from men may also simply be less likely to engage in sexual intercourse of any type. Under these circumstances, men may be less likely to have premarital sex and less likely to have sex with different partners. And even if men do marry in a demographic context where women are scarce, they may be less likely to engage in extramarital sexual relationships when there is a paucity of women in their local community. All else equal, infrequent sexual intercourse prior to, or outside of, marriage will tend to reduce men's risk of contracting an STD. This line of reasoning implies that a numerical deficit of young women will have generally benign implications for men's sexual risk behavior.

Existing research on India shows that men engage in sexually risky behavior that puts not only themselves but also their wives and partners at risk of sexually transmitted infections (including HIV/AIDS). Premarital sex is on the rise, particularly among adolescent boys and young men, with the first sexual experience consisting of largely unprotected sex, especially among rural men (Santhya et al. 2011; Somayajulu 2004; Thomas et al. 2004). Married men also engage in sexually risky behavior by having unprotected sex with multiple partners, including commercial sex workers. A substantial body of work on HIV/AIDS shows that sexual contact with commercial sex workers, having multiple partners, and sexually transmitted infections are significant predictors of HIV/AIDS in India (Doshi and Gandhi 2008; Rodrigues et al. 1995). The lack of condom acceptability among men as well as a patriarchal social structure that makes it almost impossible for monogamous women to negotiate safe sex means that husbands are the main source of infection for married women (Doshi and Gandhi 2008; Pallikadavath et al. 2005).

While there is a large body of descriptive work on sexual behavior and sexually-transmitted diseases in India, there is considerably less research on the correlates of sexual risk behavior, particularly among men. Moreover, most studies are based on localized samples, making it difficult to generalize their conclusions to the entire country. Educational attainment has been shown to have a consistent effect on sexual risk behaviors. Men with lower education initiate sex at a younger age, are more likely to engage in premarital as well as extramarital sex, and are less likely to use condoms during sex (Alexander et al. 2007; Hindin and Hindin 2009; Schensul et al. 2006). Social class and work status have also been shown to affect men's sexual behavior. Individuals in the lower economic classes and castes tend to engage in the most sexually risky behavior and to have the poorest health outcomes (Doshi and Gandhi 2008). Studies investigating slums and other low-income populations reveal high levels of premarital and extramarital sex in disadvantaged communities (Alexander et al. 2007; Santhya et al. 2011; Verma and Collumbien 2003). Economic attainment has also been shown to have an impact on sexual behavior among young men,

with more successful men being more likely to engage in premarital sex (Abraham and Kumar 1999; Alexander et al. 2007). In addition to focusing on a neglected determinant of Indian men's sexual risk behavior (the community sex ratio), our study expands on this prior body of research by using a nationally-representative sample and by exploring a wider array of possible correlates.

DATA AND METHODS

Data for this analysis come from the third wave of India's National Family and Health Survey (NFHS-3), which was collected in 2005–2006. The NFHS series is India's contribution to the Demographic and Health Surveys (DHS) program. The nationally-representative NFHS-3 consists of a household questionnaire (N=109,041) as well as separate questionnaires administered to men ages 15–54 (N=74,369) and women ages 15–49 (N=124,385). The NFHS was conducted under the stewardship of India's Ministry of Health and Family Welfare with the International Institute for Population Studies acting as the nodal agency for the surveys. The survey provides data on key indicators of demographic behavior, health, nutrition, and socioeconomic characteristics. Specific topics covered include education and work, fertility, child and maternal health, sexual behavior, women's empowerment, and domestic violence. Among the new topics in the third wave is detailed information on HIV/AIDS-related behaviors and prevalence. Our analysis draws primarily on data from the men's questionnaire although, as described below, we also draw on the household dataset to measure the community sex ratio.

Given the purposes of this analysis we delimit the NFHS-3 sample of men in three ways. First, we select only men who have resided in their current place or residence since turning age 15. Our focal explanatory variable—the community sex ratio—can only be measured at the time of the NFHS-3 administration, but some of the outcome variables refer to family and sexual behaviors that occurred in the respondents' past. Because they resided for at least part of their life in a different geographic area, men who migrated into their NFHS-3 community after age 15 were likely exposed to a different sex ratio for at least some of their adolescent and adult life. Selecting only men who resided in their current place of residence since age 15 ensures that the men in our effective sample were continuously exposed to the sex ratio in their community at the time of the NFHS-3.

Second, and for the same basic reason, we select only men who were ages 15 to 39 at the time of the NFHS-3 administration. Lacking longitudinal community-level data, we can only measure the sex ratio at the time of the survey. When they were at risk of experiencing some of the outcomes that constitute the dependent variables, the older NFHS-3 men may have been exposed to a different sex ratio than the one we are able to observe at the time of the NFHS-3 administration. Constraining the sample to younger men increases (though admittedly does not perfectly harmonize) the temporal alignment between the measured sex ratio and the behaviors that might be affected by the sex ratio.

Third, we select only men residing in a community in which at least fifty women and men contribute to the measurement of the sex ratio. We impose this restriction in order to avoid estimating community sex ratios from very small sex- and age--specific population counts. These selections result in a maximum sample of 33,695 male, non-migrant NFHS respondents ages 15 to 39. These respondents are distributed across 2,497 communities.

Dependent Variables

Our analysis incorporates multiple dimensions of men's family and sexual behavior. All of these measures are dichotomous variables. The possible effect of the sex ratio on respondents' likelihood of marrying young is captured by a variable indicating whether

respondents married prior to age 18. (Respondents who had not yet turned age 18 are excluded from this part of the analysis.) A separate dependent variable taps whether respondents had engaged in sexual intercourse prior to (or without ever) marrying, that is, whether they had engaged in premarital sexual intercourse. This variable is created by comparing respondents' reported age at marriage with their reported age at first intercourse. Another dependent variable captures whether respondents report having had two or more different sexual partners throughout their lifetime. Whether the respondent engaged in commercial sex is measured by a binary variable indicating whether any of the respondents' three most recent sex partners was a commercial sex worker. Whether the respondent harbors a sexually-transmitted disease is measured by a binary variable derived from self-reports indicating that during the past year the respondent had a disease received through sexual contact or symptoms of such a disease, including an abnormal discharge from the penis or a sore or ulcer near the penis. Although responses to questions about sexual behavior may be prone to misreporting, the rate of nonresponse to these items was low. Moreover, there is little if any reason to believe that the degree of misreporting is systematically associated with our primary explanatory variable, the community sex ratio.

Independent Variables

Our focal independent variable is the community sex ratio. Following the convention of Indian demography (Census of India 2011) and prior studies of mate availability on *men's* behavior (e.g., Lloyd and South 1996; South and Trent 2010), we measure this sex ratio as the *number of women per 100 men*. To delimit the selection of possible marital and sexual partners by age, to align it with the age range of the effective sample, and to incorporate the typical age difference between spouses, we measure the sex ratio as the number of females age 10 to 34 per 100 males age 15 to 39. We calculate this sex ratio from the NFHS-3 household questionnaires, which provide the age and sex of all members of sampled households, aggregating these counts to the primary sampling unit (PSU) level.¹ In rural areas, the PSUs are villages; in urban areas, they are census enumeration blocks. Even after restricting the sample to men who resided in a PSU in which at least 50 people contributed to the sex ratio measure, some of the female-to-male sex ratios we observed were quite extreme. To limit the influence of these extreme values, we bottom code sex ratios below 50 to that value, and we top code sex ratios above 150 to that value. (Sensitivity tests demonstrated that our results are robust to alternative strategies for dealing with extreme values of the sex ratio.) We assume that this age-staggered sex ratio observed at the time of the NFHS administration is a reasonable proxy for the unobserved sex ratio to which the older men were exposed earlier in their lives when they were at risk of experiencing the outcomes.

Of course, factors other than the sex ratio are likely to influence men's likelihood of engaging in the behaviors that constitute (or, in the case of STD status, lead to) the outcomes we examine here. Moreover, residents of communities characterized by different sex ratios may differ systematically in ways that influence the outcomes. Consequently, incorporating individual-level predictors of men's sexual behavior may help to isolate (though of course cannot prove) a causal effect of the community sex ratio on the outcomes.

Our models include dummy variables for decadal birth cohort, contrasting men born in the 1970s and the 1980s with those born in the 1960s (the reference category).² Respondent's

¹Because of the need to ensure the anonymity of the NFHS-3 respondents (primarily a consequence of the HIV test data), the NFHS-3 does not contain geographic identifiers (below the state level) that would allow us to attach census-based measures of the sex ratio specific for respondents' community of residence. Rather, it is necessary to create measures of the community sex ratio from the NFHS-3 household-level data.

²The few men born in 1990 are included in the 1980s birth cohort.

educational attainment is measured by completed years of schooling. Household wealth is a pre-constructed index using data from the household questionnaire. The composite items included indicators of household ownership of the home, land, various types of furniture, appliances, and vehicles; characteristics of the dwelling unit such as construction materials, water sources, and sanitation, and possession of a bank account. Scores on the index were derived from a principal components analysis based on all NFHS-3 households and standardized with a mean of 0 and standard deviation of 1. A dummy variable distinguishes residents of urban areas from residents of rural areas. Our models also include dummy variables for religious affiliation (distinguishing Hindu and Muslim respondents from members of other religions) and caste (distinguishing scheduled castes and scheduled tribes from other castes/tribes, including no caste or tribe).

Finally, to capture broader cultural, social, and economic influences on men's sexual risk behaviors, we include in the models a control for geographic region, contrasting residents of Southern states (Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu), Eastern states (Bihar, Orissa, West Bengal), Northeastern states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura), and Northern states (rest of India), with the latter serving as the reference category.

Analytical Strategy

To examine the effect of the numerical availability of women on men's marriage propensity, sexual behavior, and STD status, we estimate a series of logistic regression models. We compute robust standard errors that adjust for the clustering of respondents within the 2,497 communities (primary sampling units).³ Models are estimated using STATA's logit procedure (StataCorp 2005).

RESULTS

Table 1 presents variable descriptions, sample compositions, and descriptive statistics for the five dependent variables used in the analysis. Of the men aged 18 and older at the time of the survey, slightly fewer than 10% report marrying prior to turning age 18. About five percent of men engaged in sexual intercourse prior to marrying and 10% report having had two or more different sexual partners throughout their lives. Reported contact with commercial sex workers is rare. Fewer than 1% of the respondents report that at least one of their three most recent sexual partners was a commercial sex worker. Between 2% and 3% of respondents report having or exhibiting symptoms of an STD.

Table 2 presents descriptive statistics for the independent variables. Because the sample size varies across the dependent variables (see Table 1), we present descriptive statistics for the largest sample ($N = 33,695$). However, the statistics for the other samples are quite comparable (results not shown).

The mean community female-to-male sex ratio (females ages 10 to 34 per 100 males ages 15 to 39) is 113. Thus, on average men in this sample appear to have been exposed to a relative *surfeit*, rather than a numerical *deficit*, of age-matched women. Part of the reason for this surprisingly high female-to-male sex ratio is the age staggering of the numerator and denominator. Because the 10 to 14 year age group is large relative to older age groups and because only females in this age group figure into the computation of the age-staggered sex ratio, the ratio of females ages 10 to 34 to males ages 15 to 39 is somewhat inflated. Sex ratios computed from the NFHS-3 household rosters using other age ranges are somewhat

³The level of clustering of individual observations within communities about—13 men per primary sampling unit—is too low to estimate complete multilevel models of the outcomes.

more consistent with expectations (and India census figures). For example, the female-to-male sex ratio at ages 25 and older after applying our sample restrictions is 98.7, implying a numerical deficit of women. And the female-to-male sex ratio at ages 15 to 39 (i.e., without age staggering) is 103.6, considerably lower than the age-staggered sex ratio.

However, the age-staggering of the sex ratio cannot entirely explain the surprisingly high mean. Another part of the explanation appears to be that the NFHS-3 household rosters contain more women and fewer men than would be expected on the basis of census data. For household members of all ages the female-to-male sex ratio is 100, and at ages 15 to 39 it is 108. The discrepancy between the NFHS-3 sex ratios and census-derived sex ratios does not seem to stem from a biased selection of communities (PSUs) in the NFHS-3 because the NFHS-3 child sex ratio matches fairly closely the child sex ratio in census data. Perhaps because of the purpose of the survey the NFHS-3 interviewers probed more vigorously for the presence of female household members than for the presence of male household members. It is also possible that all-male households are unintentionally missed by the NFHS-3 sampling, in part because no members of these households were at home at the time of the interviewer's visit. Predominantly male institutionalized populations will also be excluded from the sample. Fortunately, however, there is no reason to think that any overenumeration of women and/or underenumeration of men varies systematically across geographic areas, so the higher-than-expected female-to-male sex ratio should not bias the observed effects of the sex ratio on the behavioral outcomes.⁴

About 9% of the men were born in the 1960s (and thus were ages 35 to 39 at the time of the survey), 34% were born in the 1970s (and were thus ages 25 to 34 at the time of the survey) and 57% were born after 1980 (and were thus ages 15 to 24 at the time of the survey). The mean level of education (completed years of schooling) is slightly more than eight years. Half of the respondents lived in an urban area at the time of the survey. The bulk of respondents reports being Hindu (74%) with smaller representations of Muslims (16%) and members of other religions (10%). About one-fifth of the respondents report belonging to a scheduled caste and about one-tenth report belonging to a scheduled tribe. About forty percent of the respondents are residents of Northern India, with residents of the Northeast, East, and South comprising about 13%, 8%, and 36% of the sample, respectively.

Table 3 presents a series of logistic regression models designed to examine the effects of the community sex ratio and the other explanatory variables on each of the dimensions of men's marital and sexual behavior. Model 1 presents the findings for the likelihood that men ages 18 and older married before turning age 18. The coefficient for the female-to-male sex ratio is positive and statistically significant. The greater the relative supply of women in the community, the more likely Indian men are to marry early in life. Yet, the effect of the sex ratio on men's marital timing is rather weak. In India, the child sex ratio (girls per 100 boys ages 0 to 6) has fallen from 96.2 in 1981 to 91.4 in 2011 (Indiastat 2011). Drawing on the coefficient for the community sex ratio in Model 1 of Table 3, a drop in the female-to-male sex ratio of 4.8 points would reduce men's odds of marrying prior to age 18 by only about 4% $[= (1 - e^{[.009](-4.8)}) * 100]$.⁵

⁴The surprisingly high mean female-to-male sex ratio would pose a problem for our analysis of the effect of the sex ratio on behavioral outcomes mainly to the extent that the effects may be nonlinear. Accordingly, we explored this possibility by estimating regression models including polynomial terms for the sex ratio. We found no evidence that the effects of the sex ratio depart significantly from linearity. We also note that while the mean female-to-male sex ratio is surprisingly high, we do observe substantial variation around the mean and, perhaps most importantly, our sample includes a substantial number of men in communities that exhibit a numerical deficit of women (i.e., a female-to-male age-staggered sex ratio less than 100). Of the 33,695 men in our effective sample, 9,738 (28.9%) are exposed to a sex ratio less than 100.

Other explanatory variables are also significantly associated with the odds that men marry before age 18. The odds of marrying prior to age 18 decrease monotonically across birth cohorts, a reflection of the secular increase in age at marriage in India. Higher levels of both education and household wealth are significantly and inversely associated with the odds of marrying prior to turning age 18. Urban residents are significantly less likely than their rural counterparts to marry this young. Net of the effects of the other predictors, Hindu men are significantly more likely than men of other (non-Muslim) religions to marry before age 18. Men living in the Northeast, East, and South regions of the country are all less likely than residents of the North to marry before turning age 18.

Model 2 of Table 3 presents the logistic regression model for men's likelihood of having had premarital sexual intercourse. Here, the coefficient for the sex ratio is positive but not statistically significant. However, other characteristics help to explain variation in Indian men's odds of having had premarital intercourse. Members of the 1980s birth cohort are significantly less likely than members of the 1960s birth cohort to have had premarital intercourse. This difference is most likely a result of the formers' more limited duration of exposure to the risk of premarital intercourse since many are still in their teenage years at the time of the survey. Higher levels of education and residence in an urban area are inversely and significantly associated with the odds of having premarital sex. Hindu and Muslim men are significantly less likely than men of other religions to have had premarital sex. Men from scheduled castes and tribes are significantly more likely than men from other castes to have had premarital intercourse. Residents of the South and East are less likely than residents of the North to have had premarital sex.

Model 3 of Table 3 is the logistic regression model for men's odds of having had two or more different sexual partners over their lifetime. Again, the coefficient for the community female-to-male sex ratio is statistically nonsignificant. The odds of having had intercourse with more than one partner decline across birth cohorts, a likely function of cohort differences in duration of exposure to multi-partnered sex. Higher levels of education and wealth are inversely associated with the likelihood of having had more than one sexual partner. As was seen for premarital sex, Muslim and Hindu men experience comparatively lower odds of having sexual intercourse with more than one partner, and members of scheduled castes and tribes exhibit comparatively higher odds. Residents of regions outside the North are significantly less likely than residents of the North to report having had two or more different sexual partners over their lifetime.

Model 4 presents the findings for the odds of having intercourse with a commercial sex worker. For this outcome we do observe a significant and inverse effect of the community sex ratio. The more women available to men, the less likely men are to engage in transactional (commercial) sex. However, while statistically significant, this effect is by no means overwhelming in magnitude. Applying the simulation described above, a drop in the female-to-male sex ratio of 4.8 points would increase men's odds of having commercial sex by only about 4% $[(e^{[-.008](-4.8)} - 1) * 100]$.

In addition to the effect of the sex ratio, members of the 1980s birth cohort are significantly more likely than members of the 1960s cohort (the reference category) to report having had commercial sex. Higher levels of education are inversely and significantly associated with the odds of having commercial sex, but greater household wealth increases the odds of

⁵In supplementary analyses we estimated a proportional hazards (Cox) model of the timing of first marriage using data from all respondents and the same explanatory variables listed in Table 3. Similar to the results of the logistic regression model, we observed a positive and statistically significant coefficient for the community female-to-male sex ratio ($b = .006$, $se = .001$, $e^x = 1.006$, $p < .001$). Thus, our findings are not sensitive to the use of age 18 to differentiate early marriages from later ones. The other explanatory variables also exhibited similar effects.

patronizing a sex worker. Residents of urban areas are significantly more likely than residents of rural areas to have had commercial sex. Hindu men are less likely than men of other (non-Muslim) religions, and residents of the South are less likely residents of the North, to engage in transactional sex.

Model 5 of Table 3 examines the determinants of men's likelihood of reporting an STD or STD symptoms during the past year. Although commercial sex is a risk factor for STDs, the effect of the community sex ratio on men's likelihood of patronizing a commercial sex worker observed in Model 4 is apparently insufficiently strong to also generate a significant association between the sex ratio and having an STD; in fact, the coefficient for the female-to-male sex ratio in Model 5 is positive although it falls far from statistical significance. Several other explanatory variables, however, are significantly associated with the risk of having an STD. Members of the 1980s birth cohort are significantly less likely than members of the 1960s birth cohort to report having an STD, and both household wealth and residence in an urban area are inversely associated with STD risk. Members of scheduled castes are more likely than other men of other castes to report having an STD or experiencing STD symptoms. Compared to the North (the reference category), the net odds of having an STD are significantly higher in the East and Northeast but significantly lower in the South.⁶

DISCUSSION AND CONCLUSION

India's numerical deficit of young adult women is likely to increase in the near future as the recent birth cohorts characterized by low female-to-male sex ratios enter adulthood. Extrapolating from the cross-sectional associations observed in this analysis (an admittedly precarious undertaking), this looming scarcity of young women may modestly shape future trends in various dimensions of men's marital and sexual risk behavior. Our results suggest that an increasing deficit of potential female partners is likely to accelerate the trend toward later age at marriage and raise young men's risk of engaging in commercial sex. However, our findings do not suggest that an increasing imbalance in the sex ratio will appreciably alter men's likelihood of having premarital or multi-partnered sexual intercourse or their chances of contracting an STD.

We acknowledge several important limitations of our analysis, particularly with respect to the measurement of the sex ratio. The community-level sample sizes of women and men used to compute the sex ratio are fairly small, and thus the resulting observed sex ratio may represent an imprecise estimate of the true community-level sex ratio. Moreover, given these small samples, the age constraint on the sex ratio (females ages 10 to 14 per males ages 15 to 39) is necessarily rather crude; it is possible that a more fine-grained age-matching of men to potential marital and sexual partners (e.g., within five-year age groups), particularly for the life course periods when men were at risk of experiencing the sexual events, may have generated stronger results. Longitudinal life-history data that would allow the sex ratio to be measured at each risk-period and treated as a time-varying covariate are also desirable. It is also possible that the rural villages and urban census enumeration blocks that constitute communities are geographically too small to circumscribe adequately the spatial boundaries of the search for marital and sexual partners. In rural areas, this limitation may be particularly acute in regions where village exogamy is the norm.⁷ Future research on the consequences of India's sex ratio imbalance for familial, sexual, and health-related behaviors may profit from redressing these limitations of our analysis.

⁶In supplementary analyses we also estimated a model for whether the respondent tested positive for HIV (based on a dried blood spot test). Here, too, we failed to observe a statistically significant effect of the community sex ratio.

It is also hazardous to extrapolate the findings from our cross-sectional analysis to future trends because men (and women) may respond to a deficit of potential partners in ways that could ameliorate any influence of the sex ratio. Minimally, such responses would include migration to geographic areas containing larger supplies of potential mates (Fan and Huang 1998), the importation of brides from other areas of the country or even from outside of India, and cross-region marriage (Kaur 2004).

Future research on the potential consequences of India's sex ratio imbalance might benefit from exploring additional outcomes. Although a numerical deficit of women may alter men's marriage propensities, it may also modify patterns of assortative mating, encouraging men to marry outside of their normative pool of spouses. For example, when faced with few potential brides, men may be more likely to marry women much younger or older than themselves or to marry women from different castes or socioeconomic classes (Edlund 1999). The resulting patterns of marital heterogamy could directly influence men's—and women's—sexual risk behavior or moderate the influences of other proximate determinants, such as commercial sex.

And of course, a comprehensive accounting of the impact of sex ratio imbalances will require analyses of how women's familial, sexual, and reproductive behaviors respond to a relative surplus of men in their marriage markets (e.g., Trent and South 2011 e.g., Trent and South 2012). Perhaps one reason for our failure to observe a significant association between the community sex ratio and men's risk of contracting an STD is that a deficit of women enhances women's power to negotiate sex and to engage in safe sexual practices, thereby counterbalancing influences that operate through the simple supply of sexual partners. For example, when women are scarce, sex workers may be better able to insist on condom use by their clients, rendering commercial sex less risky for men.

Our findings do not imply that concerns over the possible implications of India's "missing women" for men's sexual behavior and reproductive health are entirely misplaced; we do observe statistically significant if somewhat substantively modest effects of the community sex ratio on men's marital timing and likelihood of engaging in commercial sex. However, established determinants of men's marital timing and sexual risk behaviors generally exert stronger and more consistent effects. Higher levels of education, for example, tend to delay marriage and reduce the odds of engaging in premarital, multi-partnered, and commercial sexual intercourse. Accordingly, social policies designed to deter risky sexual and reproductive health behaviors among Indian men may profit more by focusing on expanding educational opportunities than by attempting to address the negative behavioral repercussions generated by India's "missing women."

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⁷Because village exogamy is practiced in most of Northern India, it is possible that the community sex ratio is less important for men in this region than for men in other regions, particularly for age at marriage. In supplementary analyses we examined this possibility by disaggregating the regression models by respondents' region of residence. We found no evidence that the association between the community sex ratio and the odds of marrying prior to age 18 varies significantly across regions. This result may suggest that the community sex ratio proxies for the sex ratio in surrounding areas, including neighboring villages, from where marital partners are selected. We also found no evidence that the effect of the sex ratio on the outcomes varies significantly between urban and rural areas.

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Descriptive Statistics for Dependent Variables Used in Analysis of Men’s Marital Timing and Sexual Behavior: India National Family and Health Survey, 2005–2006

Table 1

Variable	Description	Percent	N
Marry by Age 18	R married before turning age 18 (1=yes)	9.87	27,958
Prenatal Sex	R reports having had sexual intercourse prior to or absent marriage (1=yes)	4.71	33,676
2+ Partners	R reports having had sexual intercourse with 2 or more different partners (1=yes)	10.32	33,651
Commercial Sex	R reports that one or more of three most recent sex partners was a sex worker (1=yes)	0.53	33,695
STD	R reports having been diagnosed with a sexually-transmitted disease or displays associated symptoms in past year (1=yes)	2.46	33,504

Table 2

Descriptive Statistics for Independent Variables Used in Analysis of Men's Marital Timing and Sexual Behavior: India National Family and Health Survey, 2005–2006

<u>Variable</u>	<u>Mean</u>	<u>SD</u>
Community female-to-male sex ratio	113.22	23.99
Birth cohort		
1960	.09	.28
1970	.34	.47
1980	.57	.49
Education	8.12	4.43
Wealth	.52	9.45
Urban resident	.50	.50
Religion		
Hindu	.74	.44
Muslim	.16	.37
Other	.10	.30
Caste		
Scheduled caste	.19	.39
Scheduled tribe	.09	.29
Other	.72	.45
Region		
North	.43	.49
Northeast	.13	.34
East	.08	.28
South	.36	.48
N = 33,695		

Note: Community sex ratio measured by the number of females age 10 to 34 per 100 males age 15 to 39.

Table 3
Logistic Regression Analyses of Men's Marital Timing and Sexual Behavior: India National Family and Health Survey, 2005–2006

Independent Variables	Model 1 Marry by Age 18			Model 2 Premarital Sex			Model 3 2+ Partners			Model 4 Commercial Sex			Model 5 STD		
	b	se	e ^s	b	se	e ^s	b	se	e ^s	b	se	e ^s	b	se	e ^s
Community female-to-male sex ratio	.009**	.002	1.009	.002	.001	1.002	.002	.001	1.002	-.008*	.003	.992	.001	.002	1.001
Birth cohort															
1960	Reference			Reference			Reference			Reference			Reference		
1970	-.246**	.064	.782	-.101	.076	.904	-.120*	.059	.887	.422	.414	1.556	-.004	.115	.996
1980	-.941**	.072	.390	-1.408**	.090	.245	-.980**	.063	.375	1.004**	.387	2.729	-.619**	.119	.538
Education	-.076**	.007	.927	-.031**	.007	.969	-.032**	.005	.969	-.083**	.021	.920	-.012	.010	.988
Wealth	-.049**	.004	.952	-.001	.005	.999	-.010**	.003	.990	.025*	.011	1.025	-.022**	.006	.978
Urban resident	-.400**	.080	.670	-.208*	.083	.812	-.084	.066	.919	.445*	.211	1.560	-.309**	.107	.734
Religion															
Other	Reference			Reference			Reference			Reference			Reference		
Hindu	.332**	.117	1.394	-.395**	.090	.674	-.435**	.072	.647	-.586*	.295	.557	.169	.164	1.184
Muslim	-.142	.138	.868	-.441**	.123	.643	-.532**	.092	.587	-.195	.302	.822	.287	.196	1.332
Caste															
Other	Reference			Reference			Reference			Reference			Reference		
Scheduled caste	-.041	.064	.960	.308**	.078	1.361	.338**	.056	1.402	.320	.206	1.377	.256**	.094	1.292
Scheduled tribe	.010	.092	1.010	.444**	.101	1.559	.402**	.080	1.495	-.663	.474	.515	-.106	.147	.899
Region															
North	Reference			Reference			Reference			Reference			Reference		
Northeast	-1.351**	.112	.259	-.077	.101	.926	-.409**	.081	.664	-.331	.300	.718	.379**	.122	1.461
East	-1.042**	.114	.353	-.581**	.124	.559	-.790**	.093	.454	-.242	.326	.785	.427**	.135	1.533
South	-1.513**	.085	.220	-.358**	.077	.699	-.542**	.064	.582	-.522**	.189	.593	-.914**	.119	.401
Constant	-1.866**			-1.846			-.989**			-4.116**			-3.456**		
N	27,958			33,676			33,651			33,695			33,504		
Log-likelihood	-7267.583			-5960.064			-10539.324			-1065.342			-3665.173		

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Independent Variables	Model 1			Model 2			Model 3			Model 4			Model 5		
	Marry by Age 18			Premarital Sex			2+ Partners			Commercial Sex			STD		
	b	se	e ^s	b	se	e ^s	b	se	e ^s	b	se	e ^s	b	se	e ^s
Pseudo R ²		.193			.068			.057			.041			.052	

**
p < .01

*
p < .05

+
p < .10

Notes: Standard errors adjusted for clustering of respondents within communities. Community sex ratio measured by the number of females age 10 to 34 per 100 males age 15 to 39.