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Gender Differentials in the Seeking of Eye Care

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Gender Differentials in Eye Care: Access and Treatment

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Summary

Background A central feature of many developing countries is the presence of significant gender differentials in health outcomes. We study one potential factor which can account for this; namely, that females seek treatment later than males, and contrast this pathway with the hypothesis that females receive differential care at the medical facility.

Methods We examine gender differentials in the seeking and treatment of eye care. We study diagnostic and surgical outcomes using a unique dataset comprising a sample of 60,000 patients who sought treatment over a 3-month period in 2012 at the Aravind Eye Hospital in India. We distinguish between symptomatic and asymptomatic illness.

Findings At the time of presentation to an eye care facility, women have worse diagnoses than men across all available indicators of symptomatic illness. They have lower visual acuity and pinhole visual acuity, are more likely to be sight-impaired, and are more likely to be advised surgery or diagnosed for cataract. In contrast, males and females do not differ significantly in their "best corrected visual acuity and there are no gender differences in other indicators of surgical care – time to surgery, surgery duration, the incidence of post-operative complications, and the seniority of attending medical personnel. For asymptomatic disease, there is no significant difference between males and females: intraocular eye pressure and a high cup-to-disk ratio, which are correlates of glaucoma, are not significantly different across gender.

Interpretation The findings for symptomatic illness suggest that women seek treatment later than men for perceptible illness. That no such gender differential exists for asymptomatic disease suggests that women do not necessarily go for preventive checkups at a lower frequency than men. We find no systematic evidence that women and men receive differential medical treatment.

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1. Introduction

A central feature of many developing countries is the presence of significant gender differentials in health outcomes. The most dramatic evidence of this is excess female mortality, captured in the suspiciously low ratio of women to men, notably in India and in China (1; 2). This excess mortality is not simply confined to newborns (or pre-natal selection by gender) and infants. Recent research by Anderson and Ray (3; 4) as well as the 2011 *World Development Report* (5) highlight the following facts: (i) The bulk of excess female mortality in India and sub-Saharan Africa is at older ages, not just birth, infancy and early childhood as previously emphasized (6; 7; 8; 9; 10; 11; 12); and (ii) Almost all the "missing women" stem from disease-by-disease comparisons and not from the changing composition of disease as described by the epidemiological transition. This suggests that gender bias in health outcomes is pervasive, spanning several age groups and a variety of diseases.

Presumably, there are numerous underlying pathways for these discrepancies, ranging from differential care at home to differential medical care once treatment is sought, not to mention a plethora of other intervening factors, such as diet, stress and occupational structure. The main objective of this paper is to study just one possible factor, but a fundamental one; namely, that females *seek* treatment later than males. We also briefly contrast this pathway with the hypothesis that females *receive* differential care at the medical facility. We do this by examining gender differentials conditional on seeking eye care in an Indian hospital.

Three factors motivate our focus on eye care. First, there is the intrinsic importance of vision, a matter that directly impinges on productivity and well-being. But, of course eye care is not alone in this regard. The second factor — and in this respect eye disease is truly distinct — is that different aspects of it, such as visual acuity, myopia, cataract onset or glaucoma, are measurable with relatively high precision. Using these objective measures of disease intensity, it is possible to evaluate the extent to which eye health has deteriorated at the time of seeking care. Third, some eye diseases *are perceived as they evolve*, while others are not. The most obvious example of a symptomatic disease is, of course, the deterioration of visual acuity: loss of acuity is immediately and directly linked to the perception of that deterioration. This is certainly true of deteriorations that require corrective lenses, but it is also true for conditions such as cataract. On the other hand, conditions such as glaucoma are asymptomatic until the disease has reached an advanced stage.

In principle, then, we can distinguish between two notions of gender-based neglect in seeking medical care. One is that females do not go for regular, preventive checkups at the same frequency as males, in which case we would expect to see across-the-board discrepancies in the severity of illness (conditional on presentation at a care facility) irrespective of the symptomatic nature of the disease. On the other hand, if there is gender-based delay only in responding to the perceptible onset of illness, then we should expect to observe gender differences in disease progression at the time of presentation for symptomatic diseases, but no such differences for asymptomatic diseases.[1] To a large extent, the data we have allows us to do just that.

We summarize our findings. At the time of presentation to an eye care facility, women have worse diagnoses than men across all available indicators of symptomatic illness. They have lower visual acuity

[1]It is important to appreciate that as far as symptomatic disease is concerned, the above approach is valid independent of whether the incidence of the disease in question varies systematically across males and females, as long as the perception of disease is gender-independent.

and pinhole visual acuity, they are more likely to be sight-impaired, and are more likely to be advised surgery or diagnosed for cataract.[2] In contrast, males and females do not differ significantly in their "best corrected visual acuity and there are no gender differences in other indicators of surgical care – time to surgery, surgery duration, the incidence of post-operative complications, and the seniority of attending medical personnel.[3] For asymptomatic disease, there is no significant difference between males and females: intraocular eye pressure and a high cup-to-disk ratio, which are correlates of glaucoma, are not significantly different across gender.

2. METHODS

Sample. We use data from the Aravind Eye Hospital (or Aravind, as we refer to it hereafter) — an extraordinary network of eye-care facilities based in Madurai, India. Aravind has four main channels of service provision in the region: field camps which are set up on an *ad hoc* basis (usually over weekends) in rural areas, vision centers, which are brick-and-mortar facilities located in semi-rural areas, and two state-of-the-art hospitals located in the city of Madurai, one of which is heavily subsidized, and the other which provides services at market rates. The volume is enormous: close to a million patients, on average, have been served every year for 36 years. The economic philosophy of Aravind, one that uses high-end facilities in medical care to subsidize more spartan approaches, without stinting in any way on the medical care itself, has been much studied in both developed and developing countries as a business model (several case studies of Aravind exist, including one developed at the Harvard Business School).

Our database of over 60,000 patients is drawn from Aravind's Madurai district catchment area, collected between May and August of 2012. The database spans the paid hospital and subsidized hospital in the district capital, Madurai, as well as numerous vision centers and eye camps that operated in the region over this period. Specifically, we have medical information on: (i) the population of 13,422 *new outpatients* arriving at *vision centers* between June–August, recording the initial diagnosis as well as any vision corrections that were made; (ii) a random sample of 16,155 *new outpatients* arriving at *field camps, the paid hospital and the subsidized hospital* between May–July, recording the initial diagnosis as well as any vision corrections that were made; (iii) the population of 29,591 *cataract patients*, whose surgeries were performed in the paid and subsidized hospitals between June–August, recording the details of the surgical procedure that was followed, as well as subsequent follow-up; and (iv) a subsample of 1000 *glaucoma patients*, who first registered between 2007–2010.

Measures of Illness. The varied nature of this data allows us to put together different measures of eye conditions, and study gender discrepancies in each of them. Using the first two groups of measures outlined below, we examine whether symptomatic visual impairments and eye disease are more severe for women than men at the time of presentation. If so, then women are likely to be seeking treatment later than men. The third group of measures, corrective procedures, allows us to investigate gender differentials in medical treatment. The fourth group of measures, pertaining to asymptomatic ocular disease, permit us to explore gender differences in general (or preventive) eye care.

[2]There is a small literature that studies gender bias in children's access to care in India; see, e.g., (21; 22; 23). These papers find that families are more likely vaccinate boys relative to girls, travel longer distances for their care, and incur larger expenditures for them. Such biases are entirely consistent with our findings.

[3]Unequal or prejudicial *treatment* at the medical facility has received significant attention in high-income societies (13; 14; 15; 16; 17; 18; 19; 20).

1. *Visual Acuity.* This is a measure of the ability to see. Visual acuity is measured for all outpatients using the Snellen Tumbling-E eye chart. We convert this measure into a continuous variable with range $[0, 1]$, where 1 is perfect (i.e. $6/6$ or $20/20$) vision and 0 corresponds to cases in which, at best, only hand movement, finger counts or light could be perceived. Our measure can be roughly interpreted as the relative distance at which the patient would have to be located in order to see as clearly as a person with perfect vision.

2. *Other Symptomatic Ocular Disease.* Cataract is a clouding of the eye lens typically manifested at later ages (50+). As in more routine vision problems that need correction, cataract is symptomatic except perhaps in its earliest stage. Outpatients are routinely examined by ophthalmologists who diagnose cataract and advise surgery. This information can be coded as binary variables: e.g., surgery advisement is captured by a variable equal to 1 if surgery was advised and 0 if it was not advised. Pinhole visual acuity, which is an additional indicator of centrally located, advanced cataract, is also recorded. Our measure of pinhole visual acuity is constructed in an analogous manner to visual acuity.

3. *Treatment.* We look at several indicators connected to the actual treatment received. We record best corrected vision, which is visual acuity measured after refractive correction, as well as pinhole visual acuity following cataract surgery. We use three measures of medical treatment of cataract surgery patients: the time elapsed in minutes between hospital admission and surgery for patients who were operated on the same day as admission, surgery duration in minutes, and the surgeon's medical qualifications. We note if the cataract surgery patient spent at least one night in the hospital prior to the operation. Finally, we have two measures of cataract patient follow-up: whether or not there were post-operative complications and whether or not the patient came later than their instructed post-operative appointment, typically scheduled for one month following the operation.

4. *Asymptomatic Ocular Disease.* We study glaucoma, an eye condition resulting in damage of the optic nerve, which is asymptomatic until quite advanced, upon which it leads to progressive and irreversible loss of vision, typically proceeding from the periphery inwards. The early stages of glaucoma are highly correlated with the results of different tests, such as the measurement of cup-to-disc ratio, scores on a visual field test and intra-ocular eye pressure. It is not unusual to find glaucoma in a patient who seek care for something else entirely, perhaps a routine check-up or because of some other complaint.

Statistical Analysis. We examine gender differentials in outcomes for each of the variables described above by estimating the following regression model:

$$y_i = \alpha + \beta_1 \text{Female}_i + \gamma \text{Age}_i + \delta \mathbf{z}_i + \beta_2 \mathbf{z}_i * \text{Female}_i + \varepsilon_i$$

where y_i is the medical outcome of interest for patient i, "Female" is a dummy variable equal to 1 if patient i is female and 0 if i is male, "Age" denotes the patient's age measured in years, and $\mathbf{z}_i$ is a vector consisting of three dummy variables indicating whether the patient presented at a field camp, at the subsidized hospital or at a vision center, taking the paid hospital as the baseline. Our specification also permits two-way interactions between location dummies and the gender variable. Finally, ε_i is the error term. Our main coefficients of interest are β_1 and β_2 which indicate whether or not there exists a gender differential and whether this differential is exacerbated or ameliorated in camps, vision centers and subsidized hospitals, relative to the paid hospital. Where possible, for each of our outcomes of interest we estimate a baseline regression with only "Female" and "Age" on the right hand side, and a second regression with location dummies, before estimating the full model specified above. In our hospital cataract surgery service regressions, we also include additional controls pertaining to the patient's general health status prior to surgery.

We estimate all reported regression equations with ordinary least squares using the 'reg' command in STATA 12. (In the case of binary dependent variables, this amounts to estimating a linear probability model, but probit and logit regressions produce qualitatively equivalent results.) In each of our tables, robust standard errors are reported in parentheses under the coefficient estimates, and 1, 2, and 3 stars next to an estimated coefficient indicates that it has a p-value less than 0.10, 0.05 and 0.01, respectively.

3. Visual Acuity

We begin by examining visual acuity, in which we consider all patients arriving at Aravind who have *not* officially been registered (earlier) for either cataract surgery or glaucoma treatment. Rather than reporting outcomes for each eye separately, we follow the common convention of taking the maximum of right- and left-eye visual acuity. The average visual acuity of an individual seeking care was 0.61, a rather substantial degree of impairment, but understandable as the individuals concerned are all patients.

	Visual Acuity Without Glasses			Perfect Vision		
	[1]	[2]	[3]	[4]	[5]	[6]
Female	***-0.060	***-0.056	***-0.047	***-0.076	***-0.072	***-0.068
	(0.004)	(0.004)	(0.010)	(0.005)	(0.005)	(0.014)
Age	***-0.012	***-0.011	***-0.011	***-0.015	***-0.015	***-0.015
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Camp		***-0.074	***-0.049		**-0.017	0.003
		(0.007)	(0.009)		(0.009)	(0.013)
Female*Camp			***-0.048			**-0.039
			(0.013)			(0.017)
Subsidized Hospital		***-0.077	***-0.085		***-0.067	***-0.071
		(0.008)	(0.012)		(0.010)	(0.015)
Female*(Subs Hospital)			0.012			0.007
			(0.015)			(0.020)
Vision center		***0.035	***0.036		***0.077	***0.075
		(0.005)	(0.008)		(0.008)	(0.011)
Female*(Vision center)			-0.002			0.005
			(0.011)			(0.016)
Constant	***1.152	***1.118	***1.114	***1.127	***1.064	***1.063
	(0.005)	(0.007)	(0.008)	(0.007)	(0.010)	(0.012)
Observations				22,990	22,990	22,990
R-squared	22,990	22,990	22,990	0.356	0.366	0.366

TABLE 1. **Correlates of Uncorrected Visual Acuity and Perfect Vision Among New Outpatients** *Note.* In the regressions with outlet controls, "paid hospital" forms the baseline. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The first column of Table 1 indicates that females come in with significantly lower visual acuity, the difference being around 6 percentage points or 10% of the mean. Columns 2 and 3 add more controls. Column 2 takes the paid hospital as the baseline, and adds in shifters for eye camps, vision centers, and the subsidized hospital in Madurai. It is evident that individuals presenting at the camps and subsidized hospital are doing so with worse eyesight than at the paid hospital or at the vision centers. Moreover, eye camps exacerbate even the gender *differential*, as the interaction effects in Column 3 reveal. Because camps cater to the poorest of the patient segments, that suggests that both the level of health at presentation and the gender differential are highest among the poor.

	Sight Impaired			Severely Sight Impaired		
	[1]	[2]	[3]	[4]	[5]	[6]
Female	***0.089	***0.082	***0.050	***0.009	***0.008	0.008
	(0.008)	(0.008)	(0.019)	(0.003)	(0.003)	(0.006)
Age	***0.016	***0.015	***0.015	***0.002	***0.002	***0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Camp		***0.198	***0.156		***0.049	***0.046
		(0.013)	(0.017)		(0.005)	(0.007)
Female*Camp			***0.082			0.005
			(0.024)			(0.011)
Subsidized Hospital		***0.146	***0.169		-0.005	-0.002
		(0.016)	(0.023)		(0.005)	(0.007)
Female*(Subsidized Hospital)			-0.035			-0.005
			(0.031)			(0.010)
Vision center		***0.057	***0.042		-0.002	-0.002
		(0.011)	(0.015)		(0.004)	(0.005)
Female*(Vision center)			0.029			-0.000
			(0.022)			(0.007)
Constant	***-0.531	***-0.551	***-0.538	***-0.098	***-0.092	***-0.092
	(0.023)	(0.023)	(0.024)	(0.010)	(0.011)	(0.011)
Observations	12,957	12,957	12,957	12,957	12,957	12,957
R-squared	0.105	0.127	0.128	0.014	0.029	0.029

TABLE 2. **Correlates of Sight Impairment and Severe Sight Impairment, All Outlets ages 41+** *Note.* In the regressions with outlet controls, "paid hospital" forms the baseline. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Other aspects of visual acuity shed further light on the story. Consider, for instance, the incidence of a perfect visual acuity score, or 20-20 vision (a "1" in our dataset).[4] The data in columns 4–6 of Table 1 shows clearly that a significantly larger fraction of males present with perfect visual acuity scores. Subsidized hospital patients fare worst, followed by eye camp patients where once again there is an accentuated

[4]Why might a patient with perfect acuity go to an eye care facility to begin with? The answer must lie in some incident that caused temporary discomfort, such as debris in the eye or ancillary occurrences that might be suggestive of an eye problem but are not, such as recurrent headaches.

gender differential. As in the case of average visual acuity, vision centers come out relatively well, which is not especially surprising as vision centers typically deal with more routine visits.

Table 2 follows up by studying *sight impairment*, defined as a condition in which visual acuity is 2/6 or below. Because sight impairment is relatively rare among the young, we focus on older adults (41+). Columns 1–2 exhibit a robust parallel with the corresponding columns in Table 1. Females are approximately 8 percentage points more likely to be sight-impaired. The difference is high, given that the average incidence of sight impairment is around 28%. Column 3 indicates that, once again, camps fare the worst, with both the incidence of sight impairment and the differential heightened in these locations. (This time both the subsidized hospital and the vision centers also do badly relative to paid hospital on both these counts.) Columns 4–6 show that these results also persist with severe sight impairment, a condition in which visual acuity is 3/60 or worse. Women are close to one percentage point more likely to be severely sight impaired, which is again a large differential as the average incidence of severe sight impairment is around 2.2%.

4. Other Symptomatic Ocular Disease

We consider three measures of symptomatic disease. The first is the advisement of surgery. Often, such advisement has to do with the presence of cataract, but this is not an exclusive correlate. Our second outcome is whether cataract was diagnosed in a patient. We use the new outpatient sample of patients aged 41+ to assess these two outcomes. Third, we study *pinhole visual acuity* in the full cataract surgery patient sample. The test is a measure of potential best vision,[5] but if a cataract is centrally situated or sufficiently advanced, the reduced amount of light coming through the pinhole will make the test harder for the patient. Therefore low scores on the pinhole are correlated with advanced cataract. In addition, low pinhole scores are indicative of real loss of potential vision, as would be the case with degeneration of the retina. Table 3 records the results.

Columns 1–3 regresses the binary variable "surgery advised" against the same set of variables used in the earlier tables. In all the specifications, females are significantly more likely to be recommended surgery than males. This is true even of the specification in column 3, in which where the direct "female effect" is insignificant. Whereas the baseline category of "paid hospital" does not exhibit any gender differential, the positive and significant interaction terms for camps and the subsidized hospital indicate sizable gender differentials in these locations.

Columns 4–6 study the binary variable "cataract diagnosis". Once again we see that women are significantly more likely than men to be diagnosed with cataract, conditional on arrival at a clinic. The difference is present for all types of facilities, and is significantly higher at the vision centers.

Columns 7–9 examine pinhole visual acuity among cataract surgery patients of all ages, prior to surgery. The location controls here refer to the place at which the patient initially presented as an outpatient, which in our sample does not include vision centers. Once again, the verdict is unambiguous: females have worse pinhole acuity than males, an indicator of ocular disease of some kind. Column 9 indicates that this gender gap is driven by subsidized hospital and not paid hospital patients.

[5]A pinhole occluder (an opaque disk with a small hole in it) is used to test the strength of the patient's "potential" vision. The pinhole temporarily eliminates refractive errors because the line of sight is restricted to pass through the center of the lens.

	Surgery Advised			Cataract Diagnosed			Pinhole Visual Acuity		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Female	***0.080	***0.071	0.018	***0.024	***0.025	***0.006	***-0.032	***-0.020	-0.010
	(0.007)	(0.007)	(0.013)	(0.005)	(0.004)	(0.002)	(0.003)	(0.003)	(0.006)
Age	***0.011	***0.009	***0.009	***0.004	***0.005	***0.005	***-0.005	***-0.005	***-0.005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Camp		***0.236	***0.167		***-0.019	***-0.022		***-0.166	***-0.166
		(0.010)	(0.013)		(0.001)	(0.002)		(0.004)	(0.006)
Female*Camp			***0.142			***0.006			-0.001
			(0.019)			(0.002)			(0.008)
Subsidized Hospital		***0.344	***0.310		***-0.019	***-0.021		***-0.118	***-0.102
		(0.013)	(0.019)		(0.002)	(0.002)		(0.004)	(0.006)
Female*(Subsidized Hospital)			***0.068			***0.007			***-0.028
			(0.026)			(0.003)			(0.008)
Vision center		***-0.033	***-0.031		***0.282	***0.260			
		(0.008)	(0.012)		(0.006)	(0.008)			
Female*(Vision center)			-0.003			***0.045			
			(0.017)			(0.011)			
Constant	***-0.324	***-0.301	***-0.282	***-0.122	***-0.281	***-0.270	***0.974	***1.039	***1.033
	(0.020)	(0.019)	(0.020)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Observations	17,190	17,190	17,190	17,190	17,190	17,190	28,918	28,918	28,918
R-squared	0.055	0.149	0.154	0.015	0.232	0.233	0.033	0.090	0.090

TABLE 3. **Correlates of Other Ocular Disease** *Note.* The sample in columns 1-6 contains new outpatients aged 41+ presenting at paying hospitals, subsidized hospitals, vision centers and camps. The sample in columns 7-9 contains cataract surgery patients of all ages. In the regressions with outlet controls, "paid hospital" forms the baseline. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

It is remarkable that so many distinct indicators of care point to a unified conclusion: that females appear to seek medical care systematically later than males. We hasten to point out that this conclusion stands irrespective of the incidence of such disease in the population at large. For instance, the results do not change in their interpretation even if women biologically tend to be afflicted by cataract to a far greater degree than men. All that matters is the stage of a symptomatic disease at which an individual seeks attention.

We note two qualifications. First, there may be intrinsic gender-based differences in disease perception, in which case gender differentials would arise even without any discrimination. We are not aware of any study that examines this question, and see no reason to entertain such an assumption. Second, even in the absence of intrinsic differences, there may be differences in the "technology of perception" that are induced by socioeconomic background. One immediate factor that comes to mind is differential school attendance: if girls have a lower attendance rate, that might make for later detection. Similarly, differences in occupational structure could be related to differential rates in perception. These issues are potentially important but beyond the scope of the current paper.

5. Medical Care

It can be argued that gender health differentials are driven not by late access to health care, but by the very nature of the care itself, which might be discriminatory. Table 4 explores this possibility. In columns 1 and 2 of that table there is no suggestion at all that best corrected visual acuity after refractive correction in outpatients is worse for females than for males. Indeed, column 3 reveals that females are actually better off than males in the paid and subsidized hospitals (the negative interaction terms offset the positive female effect for vision centers and camps). Overall, gender differentials in best corrected vision are essentially absent in these columns. However, columns 4–6 report on visual acuity post-cataract surgery; the sample this time is the set of all cataract patients. Here, the results in all three columns do indicate that women fare worse than men following surgery.

Two factors might account for this difference relative to the results for best corrected vision. First, while the disease in question may be reversible (say, cataract with no further complications), the medical staff have not done enough to reverse the gender differential that existed pre-surgery. Alternatively, the gap in postoperative acuity may reflect a deeper malaise with vision, such as retinal degeneration, which may have accompanied the cataract, causing irreversible damage. While the data do not permit us to directly address the distinction, we can examine other aspects of the surgical process to see if there is any gender differential on those counts. Table 5 considers hospital service for cataract surgery patients. Since this is likely to depend on the patient's medical condition, we control with the inclusion of 4 binary variables indicating whether ($= 1$) or not ($= 0$) a patient has high blood pressure, a cardiovascular condition, hypertension, or diabetes, prior to surgery.

Columns 1–3 capture the duration of patients' hospital stay, for which data are available only for the paid hospital. The dependent variable in column one is a dummy variable indicating whether the patient stayed at the hospital for at least one night prior to surgery ($= 1$) or had surgery on the day of admission ($= 0$). It indicates that females are less likely to be treated as inpatients. Controlling for pre-surgical medical conditions and given that patients in this hospital are paying out of pocket, this indicates that women or their families are less likely to admit themselves to hospitals as inpatients prior to surgery. By contrast, columns 2 and 3 explore decisions made by medical staff at the hospital. It indicates that for patients

	BCV			Post-Operative Visual Acuity		
	[1]	[2]	[3]	[4]	[5]	[6]
Female	0.007	0.000	**0.028	***-0.047	***-0.022	***-0.025
	(0.005)	(0.004)	(0.012)	(0.003)	(0.003)	(0.007)
Age	***-0.005	***-0.004	***-0.004	***-0.004	***-0.004	***-0.004
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Camp		***-0.175	***-0.149		***-0.270	***-0.276
		(0.015)	(0.020)		(0.004)	(0.006)
Female*Camp			*-0.058			0.010
			(0.031)			(0.008)
Subsidized Hospital		***-0.107	***-0.121		***-0.303	***-0.298
		(0.022)	(0.030)		(0.004)	(0.006)
Female*(Subs Hospital)			0.033			-0.007
			(0.043)			(0.008)
Vision center		***0.106	***0.125			
		(0.006)	(0.009)			
Female*(Vision center)			***-0.037			
			(0.012)			
Constant	***1.066	***0.975	***0.960	***0.749	***0.883	***0.884
	(0.006)	(0.008)	(0.010)	(0.012)	(0.012)	(0.012)
Observations	8,717	8,717	8,717	23,195	23,195	23,195
R-squared	0.159	0.256	0.257	0.030	0.285	0.285

TABLE 4. **Correlates of Best Corrected Vision and Post-Operative Visual Acuity**
Note. Columns 1–3 contains new outpatients presenting at paying hospitals, subsidized hospitals, vision centers and camps. Columns 4–6 pertain to cataract surgery patients. In the regressions with outlet controls, "paid hospital" forms the baseline. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

whose surgery transpires on the same day as their hospital admission, females are moved faster to surgery by doctors, with a waiting time to surgery which is about 7 minutes shorter. Column 3 indicates that there surgery times for women are slightly shorter than than for men, but the difference is only marginally significant.

Columns 4–6 look at the difference in the probability of being operated upon by a full Medical Officer or Senior Medical Officer. (Fellows and "post graduate" residents also perform surgery.) The results in columns 4 and 5 indicate that females are less likely to be operated upon by medical officers. Column 6 indicates this differential is absent in the paid hospital, and reflects gender difference in treatment at the subsidized hospital. The overall probability of being operated by a medical officer is well over 50% so the differences, while significant, are really small. Table 6 follows up on the concern that women might face more postoperative complications as the result of being treated by less qualified surgeons. But as the first three columns of that table reveal, complications are practically nonexistent, and so are any gender differences in complications. This suggests that the assignment of medical officers to patients

	Stayed at least one night	Surgery Wait if same day	Surgery Duration	Surgeon is Medical Officer		
	[1]	[2]	[3]	[4]	[5]	[6]
Female	***-0.036	**-6.970	*-1.632	***-0.042	**-0.014	0.004
	(0.012)	(3.391)	(0.983)	(0.006)	(0.006)	(0.004)
Age	***-0.003	-0.141	-0.023	***-0.003	-0.000	-0.000
	(0.001)	(0.163)	(0.056)	(0.000)	(0.000)	(0.000)
High Blood Pressure	***-0.034	*6.363	0.651	***0.077	0.004	0.004
	(0.013)	(3.358)	(1.043)	(0.007)	(0.006)	(0.006)
Cardiovascular	*0.037	-5.963	**-2.690	***0.105	0.008	0.010
	(0.021)	(4.372)	(1.315)	(0.010)	(0.007)	(0.007)
Hypertension	0.013	***10.347	0.873	***0.226	0.007	0.006
	(0.015)	(3.827)	(1.247)	(0.006)	(0.005)	(0.005)
Diabetes	*0.024	1.395	0.933	***0.223	0.000	0.002
	(0.014)	(3.762)	(1.209)	(0.006)	(0.005)	(0.005)
Camp					***-0.480	***-0.470
					(0.006)	(0.009)
Female*Camp						-0.019
						(0.012)
Subsidized Hospital					***-0.431	***-0.416
					(0.006)	(0.009)
Female*(SubsHospital)						**-0.028
						(0.012)
Constant	***0.738	***141.537	***14.519	***0.782	***0.981	***0.974
	(0.034)	(10.357)	(3.463)	(0.016)	(0.015)	(0.014)
Observations	6,498	2,906	6,493	24,372	24,372	24,372
R-squared	0.007	0.006	0.001	0.072	0.187	0.187

TABLE 5. **Correlates of Hospital Service** *Note.* The sample in columns 1 and 2 pertain to cataract surgery patients in the paid hospital. The dependent variable in column 1 is the difference between hospital admission and surgery and in column 2, it is surgery duration, both measured in minutes. Columns 3-5 pertain to all cataract surgery patients. In the regressions with outlet controls, "Paid Hospital" forms the baseline. The dependent variable is a dummy variable equal to 1 if the surgery was performed by a medical officer or senior medical and 0 otherwise. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

corresponds to the complexity of the case rather than the gender of the patient. Late followups are a concern: the number is around 30% on the whole and significantly higher for the poorer patients who originally came in via the camps. But there are no gender differentials to speak of.

We have already seen that gender differentials are high at the level of access. Following treatment, those differentials are nonexistent or small. We must conclude that there is little evidence of differential *treatment* of males and females, though some differences in initial conditions appear to persist post-surgery.

	Post-Operative Complications			Late Follow-Up		
	[1]	[2]	[3]	[4]	[5]	[6]
Female	-0.001	-0.000	0.003	0.001	-0.007	-0.002
	(0.002)	(0.002)	(0.004)	(0.006)	(0.006)	(0.011)
Age	***0.001	***0.001	***0.001	0.000	***-0.001	***-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Camp		*-0.004	-0.002		***0.212	***0.212
		(0.003)	(0.004)		(0.007)	(0.011)
Female*Camp			-0.005			-0.002
			(0.005)			(0.015)
Subsidized Hospital		**-0.005	-0.003		***-0.025	-0.014
		(0.002)	(0.004)		(0.008)	(0.012)
Female*(SubsHospital)			-0.004			-0.020
			(0.005)			(0.015)
Constant	***-0.024	***-0.021	***-0.023	***0.333	***0.321	***0.318
	(0.006)	(0.006)	(0.006)	(0.021)	(0.021)	(0.021)
Observations	29,598	29,598	29,598	23,290	23,290	23,290
R-squared	0.003	0.003	0.003	0.000	0.054	0.054

TABLE 6. **Correlates of Post-Operative Outcomes** *Note.* This sample contains cataract surgery patients. In the regressions with outlet controls, "paid hospital" forms the baseline. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6. Asymptomatic Disease

We study two indicators of glaucoma, which is largely asymptomatic until the disease is at an advanced (and irreversible) stage. One is the cup-to-disc ratio, used to assess the progression of glaucoma. This ratio compares the diameter of the "cup" of the optic disc with the overall diameter of the disc. There is population variation in this ratio, but what is important is that glaucoma causes the ratio to grow. A second correlate is intraocular eye pressure (IOP), which measures fluid pressure within the eye. Any comprehensive eye examination will include this measurement; ocular hypertension refers to elevated values of IOP. Again, there is population heterogeneity, but a steady increase in IOP is an important indicator of glaucoma.

Table 7 reports on gender differentials in these indicators among the patients in our sample. Note that with asymptomatic disease, population incidence does matter in interpreting the findings. Fortunately for our purposes, studies on gender as a risk factor for glaucoma are inconclusive. Previous research (24; 25; 26; 27) finds no association between sex and the prevalence of glaucoma,[6] particularly for the most common form of glaucoma, which is of the primary open-angle variety. There is also little or no

[6]Some of these studies do find significant results, but running in either direction on gender.

	Cup Disc Ratio		IOP	
	[1]	[2]	[3]	[4]
Female	*-0.013	-0.102	-0.086	-0.020
	(0.007)	(0.079)	(0.078)	(0.137)
Age	***0.002	***0.013	**0.010	**0.010
	(0.000)	(0.004)	(0.005)	(0.005)
Camp			***0.245	*0.238
			(0.091)	(0.134)
Female*Camp				0.010
				(0.169)
Subsidised Hospital			***-1.690	***-1.515
			(0.131)	(0.224)
Female*(Subsidised Hospital)				-0.315
				(0.265)
Vision center			***-1.754	***-1.720
			(0.112)	(0.156)
Female*(Vision center)				-0.069
				(0.226)
Constant	***0.635	***14.982	***15.809	***15.778
	(0.020)	(0.262)	(0.268)	(0.266)
Observations	849	10,743	10,743	10,743
R-squared	0.058	0.001	0.053	0.054

TABLE 7. **Correlates of Glaucoma – Asymptomatic, Ages 41+** *Note.* The Cup Disc Ratio sample (column 1) pertains only to glaucoma patients treated at hospitals. The IOP sample (columns 2-4) comprises new outpatients. In the regressions with outlet controls, "paid hospital" forms the baseline. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

connection between the *correlates* of glaucoma that we examine here, and gender; see, for instance (28) and (29) for intraocular eye pressure,[7] and (30) for cup-to-disc ratios.

With that in mind, Table 7 suggests that when the disease in question is *asymptomatic*, as glaucoma in its early stages tends to be, there is no significant difference between males and females. Females in our glaucoma patient sample have a slightly lower cup-to-disc ratio (column 1) and there is no difference at all in intraocular eye pressure for outpatients (columns 2-4). Either individuals of both genders in India go in for preventive health checkups at similar intervals, or more likely, they don't go in for such checkups at all. In any event there is no discernible gender differential.

The gender contrast between symptomatic and asymptomatic disease is, in our opinion, an important finding. Assuming that males and females have an equal ability to perceive illness, the fact that a female goes late (or is taken late) to seek medical care for a symptomatic disease is noteworthy.

[7]There is some evidence that women tend to have higher IOP following menopause.

7. Summary and Discussion

We document gender differentials in the seeking of eye care. Such differentials are significant along many dimensions. Females present with lower uncorrected visual acuity than males. They have a lower incidence of perfect vision. They are more likely to be sight-impaired. They are more likely to be advised surgery. They are more likely to be diagnosed for cataract. They have lower pinhole visual acuity, which is a separate indicator for the existence of disease quite apart from the need for refractive correction.

All these differences are robust to the inclusion of age as a control, as well as to the use of controls for different eye care facilities, entered with or without interaction with gender. We also observe that these indicators (for males and females together) are generally at their nadir at the eye camps, where at the same time the gender differentials for many of these indicators are at their widest. This is true even relative to the paid hospital, where the proportion of seriously ill patients could reasonably have been expected to be higher. That suggests that the poorest individuals, who predominantly attend the camps, have the lowest average rate of access and also the largest differential in access between males and females.

Yet, following the refractive correction that takes place during the visit, males and females do not differ significantly in their "best corrected" visual acuity. The medical facility appears to treat male and female vision patients with equal care: they are brought up to par with each other. This is not entirely the case, however, for post-operative visual acuity, where differences remain. Without further investigation, it is hard to say what causes the discrepancy in visual acuity after surgery. It could conceivably be unequal care at the facility. To further investigate this, we look at other indicators of surgical care received: time to surgery, surgery duration, post-operative complications, and the seniority of attending medical personnel.

Women in the paid hospital are less likely to be admitted at least one night before cataract surgery. This likely reflects the reluctance of the individual or family (rather than the doctor) to admit women into hospitals early, though after surgery there is no gender differential in followup. As for treatment by hospital staff, female surgery outpatients are kept waiting for a shorter time than male outpatients between admission and surgery. Females are less likely to be treated by a medical officer in subsidized hospitals, but this does not seem to have any repercussions in terms of surgical procedure: surgery duration for females is marginally shorter, and there are no gender differentials in post-operational complications.

Finally, when the disease in question is asymptomatic, as glaucoma in its early stages tends to be, there is no significant difference between males and females. Intraocular eye pressure is not significantly different across gender and neither is a high cup-to-disk ratio. That supports our presumption that for diseases that are initially asymptomatic, there is no significant difference between males and females at presentation (We use secondary information to argue that there is not a large difference in the population to begin with.). It is precisely when a disease is linked to the direct perception of it, as in the case of bad eyesight that requires simple correction, that males and females seem to present differently: on the assumption that perception itself is not gender-specific, males (or the parents of males) appear more responsive to their perceptions of ill-health.

Improving health outcomes in developing countries is, first and foremost, of central intrinsic importance. Resolving gender-based health inequalities remains at the forefront of development policy. But we need to know where the inequalities lie. In particular, we need to understand whether (as studied in this paper) inequality exists at the level of access or at the level of treatment. But there are many other issues that are inextricably tied up in the intersection of economics, sociology, culture and health, which no doubt drive these differences and warrant further study.

REFERENCES

[1] Coale AJ. Excess female mortality and the balance of the sexes in the population: an estimate of the number of "missing females". The Population and Development Review. 1991;p. 517–523.

[2] Coale AJ, Demeny P, Vaughan B. Regional model life tables and stable populations. vol. 41. Academic Press New York; 1983.

[3] Anderson S, Ray D. Missing women: age and disease. The Review of Economic Studies. 2010;77(4):1262–1300.

[4] Anderson S, Ray D. The Age Distribution of Missing Women in India. Economic and Political Weekly. 2012;47:87–95.

[5] World Bank. World Development Report. World Bank Washington D.C.; 2011.

[6] Jha P, Kumar R, Vasa P, Dhingra N, Thiruchelvam D, Moineddin R. Low male-to-female sex ratio of children born in India: national survey of 1.1 million households. The Lancet. 2006;367(9506):211–218.

[7] Das Gupta M. Explaining Asia's missing women: A new look at the data. Population and Development Review. 2005;31(3):529–535.

[8] Sudha S, Rajan SI. Female demographic disadvantage in India 1981–1991: sex selective abortions and female infanticide. Development and Change. 2002;30(3):585–618.

[9] Deaton A. Looking for boy-girl discrimination in household expenditure data. The World Bank Economic Review. 1989;3(1):1–15.

[10] Oster E. Proximate sources of population sex imbalance in India. Demography. 2009;46(2):325–339.

[11] Pande RP, Yazbeck AS. What's in a country average? Wealth, gender, and regional inequalities in immunization in India. Social Science & Medicine. 2003;57(11):2075–2088.

[12] Garg A, Morduch J. Sibling rivalry and the gender gap: Evidence from child health outcomes in Ghana. Journal of Population Economics. 1998;11(4):471–493.

[13] Abuful A, Gidron Y, Henkin Y. Physicians' attitudes toward preventive therapy for coronary artery disease: Is there a gender bias? Clinical cardiology. 2005;28(8):389–393.

[14] Daly C, Clemens F, Sendon JLL, Tavazzi L, Boersma E, Danchin N, et al. Gender differences in the management and clinical outcome of stable angina. Circulation. 2006;113(4):490–498.

[15] Ayanian JZ, Epstein AM. Differences in the use of procedures between women and men hospitalized for coronary heart disease. New England Journal of Medicine. 1991;325(4):221–225.

[16] Glader EL, Stegmayr B, Norrving B, Terént A, Hulter-Åsberg K, Wester PO, et al. Sex differences in management and outcome after stroke a Swedish national perspective. Stroke. 2003;34(8):1970–1975.

[17] Chang AM, Mumma B, Sease KL, Robey JL, Shofer FS, Hollander JE. Gender bias in cardiovascular testing persists after adjustment for presenting characteristics and cardiac risk. Academic Emergency Medicine. 2007;14(7):599–605.

[18] Petrea RE, Beiser AS, Seshadri S, Kelly-Hayes M, Kase CS, Wolf PA. Gender differences in stroke incidence and poststroke disability in the Framingham Heart Study. Stroke. 2009;40(4):1032–1037.

[19] Schulman KA, Berlin JA, Harless W, Kerner JF, Sistrunk S, Gersh BJ, et al. The effect of race and sex on physicians' recommendations for cardiac catheterization. New England Journal of Medicine. 1999;340(8):618–626.

[20] Chandra A, Staiger DO. Identifying provider prejudice in healthcare; 2012. Mimeo, Harvard University.

[21] Borooah VK. Gender bias among children in India in their diet and immunisation against disease. Social Science & Medicine. 2004;58(9):1719–1731.
[22] Pandey A, Sengupta PG, Mondal SK, Gupta DN, Manna B, Ghosh S, et al. Gender differences in healthcare-seeking during common illnesses in a rural community of West Bengal, India. Journal of Health, Population and Nutrition. 2011;20(4):306–311.
[23] Mishra V, Roy TK, Retherford RD. Sex differentials in childhood feeding, health care, and nutritional status in India. Population and development review. 2004;30(2):269–295.
[24] Varma R, Paz SH, Azen SP, Klein R, Globe D, Torres M, et al. The Los Angeles Latino Eye Study: design, methods, and baseline data. Ophthalmology. 2004;111(6):1121–1131.
[25] Hoffmann EM, Zangwill LM, Crowston JG, Weinreb RN. Optic Disk Size and Glaucoma. Ophthalmology Clinics of North America. 2007;52(1):32–49.
[26] Quigley HA. Number of people with glaucoma worldwide. British Journal of Ophthalmology. 1996;80(5):389–393.
[27] Klein B, Klein R, Sponsel W, Franke T, Cantor L, Martone J, et al. Prevalence of glaucoma. The Beaver Dam Eye Study. Ophthalmology. 1992;99(10):1499–1504.
[28] Senol D, Murat A, Taylan YA, Kenan G. Sex-related differences in intraocular pressure in healthy young subjects. Perceptual and Motor Skills. 2003;96(3):1314–1316.
[29] Mitchell P, Smith W, Attebo K, Healey P. Prevalence of open-angle glaucoma in Australia. The Blue Mountains Eye Study. Ophthalmology. 1996;103(10):1661–1669.
[30] Huynh SC, Wang XY, Rochtchina E, Crowston JG, Mitchell P. Distribution of optic disc parameters measured by OCT: findings from a population-based study of 6-year-old Australian children. Investigative ophthalmology & visual science. 2006;47(8):3276–3285.

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