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Is there an association between public spending on health and choice of healthcare providers across socioeconomic groups in India? - Evidence from a national sample

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ABSTRACT

The role of public spending on health in reducing socioeconomic inequalities in healthcare is an emerging area of research, little supporting empirical evidence is available from low- and middle-income countries. This study examined: (1) the relationship between public spending on health per capita and the decision whether to seek healthcare or not, (2) the relationships between public spending on health per capita and choice of medical provider, and (3) whether these relationships varied by socioeconomic groups in India.

Our study utilized the nationally representative 71st National Sample Survey of India, using 26,142 people who had been ailing in the past 15 days, the survey took place between the 1st of January and June 30, 2014. Two regression-based approaches were used to examine the association between public spending and choice of medical providers: (1) Multilevel multinomial regression; and (2) Instrumental variable regression. We examined the differential impacts of public spending on healthcare utilisation by socioeconomic groups.

Increased public spending on health was not associated with changes in ailing people's decision whether to seek care or not ($p > 0.05$ in all analyses). However, increased public spending on health was associated with reductions in patients choosing private medical providers [adjusted odds ratio = 0.88 (95%CI 0.85–0.91) for outpatient private clinics] compared to outpatient government clinics. These associations may be greater among the lower economic groups compared with their counterparts.

Across India, higher levels of government investment in health services are recognised by healthcare users and shown in their pattern of healthcare utilisation. That an increase in public spending on health results in a decrease in the use of private providers, particularly outpatient facilities with no inpatient capabilities, provides strong evidence for the effectiveness of 'regulation by competition'. This is a strong argument for focusing health system strengthening, and strategies for achieving universal healthcare on public investment.

1. Introduction

Since the publication of the World Health Report on Universal Healthcare Coverage (UHC) in 2013 (Research for universal he, 2013), there has been an acceleration of interest in achieving UHC - defined as ensuring timely access to quality healthcare without financial hardship, especially for the poor (General Assembly. Tran, 2015). In India, socioeconomic inequalities in health are very evident (Rama et al., 2010; Sakthivel and Anup, 2009; Shankar et al., 2013), with the poor having significantly earlier mortality (Saikia et al., 2019) and reporting greater difficulties in access to health care than their rich counterparts (Sheikh and George, 2012).

In India patients seek healthcare from a variety of providers (Sheikh and George, 2012; Drèze and Sen, 2013; Mackintosh et al., 2016; McPake and Hanson, 2016; Montagu and Goodman, 2016; Morgan et al., 2016), which range from high-quality specialist services to unregulated, in some cases hazardous providers, and traditional services (Sheikh and George, 2012). Recent analysis of national survey data showed that most

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primary care in rural India is delivered by private informal providers without formal medical qualifications (Das et al., 2016), and private health services are preferred compared to government services (International Institute f, 2015), despite out-of-pocket user fees for patients generally being lower in the latter (Mohanty and Srivastava, 2013). A variety of reasons have been reported for the non or low use of government services; these include, but are not limited to, long waiting times (Morgan et al., 2016), lack of geographical access (Borah, 2006), and frequently absent healthcare staff (Morgan et al., 2016).

According to the World Bank, India's public spending on health in 2016 was 0.9% of its Gross Domestic Product (World Bank. Domestic gene, 2019a), significantly lower than other countries with similar levels of GDP per capita such as Vietnam [2.7% (World Bank. Domestic gene, 2019b)] or the Philippines [1.4% (World Bank. Domestic gene, 2019c)]. Importantly, the national average masks significant heterogeneity across states in India, with public spending per capita on health in Kerala and Tamil Nadu, of INR 1033 and INR 935, respectively being double that of Bihar and Uttar Pradesh (INR 385 and INR 492, respectively) (Central Bureau of Health Intelligence, 2016)). This is due to differences in wealth between states and the way the Indian Constitution assigns the responsibility for health to the states. In 2015–16, only 35.6% of the public spending on health was financed by the Union Government, so that states' access to resources and their budgetary allocation decisions influence the level and distribution of the remaining (almost) two-thirds of government health spending. (Ministry of Health and Family Welfare, 2018).

Recently the Indian Union government has set out an ambitious a plan to inject substantial new funds into the healthcare sector. These major health system reforms include plans to upgrade 150,000 public primary health centres by 2022 (Lahariya, 2018) and to provide the poorest 100 million households, encompassing 500 million people, with health insurance coverage worth up to INR 500,000 (approximately USD 6500) annually (Suvansh et al., 2019). It is projected that these reforms will result in sharp increases in government health spending per capita leading to a rise in India's share of government health spending in GDP to 2.5% by 2025 (Nirula et al., 2019).

The role of private sector in achieving UHC in LMICs is a subject of intense debate (Expert, 2011; Shah, 2010). In India, due to insufficient government funding for the public health system, a large proportion of health services are provided by the private sector (Mackintosh et al., 2016). Recent analysis shows that the proportion of care provided by the private sector has grown larger since the 1980s for outpatient care in urban areas and for all inpatient care (Sakthivel and Anup, 2009). Despite the growing use of private healthcare providers in India, there is little attention given to the implication of increased public spending on health, and on healthcare utilisation in public versus private medical providers in India.

A brief literature search reveals much is known about the protective effect of public health spending on population health, both in India (Duggal, 2007; Farahani et al., 2010) and in other LMICs (Bokhari et al., 2007; Makuta and O'Hare, 2015), however the potential mechanisms by which associations are transmitted from public spending on health to health outcomes remain unclear. For example, analysis by Farahani et al. (2010) found that a 10% increase in public health expenditure reduced all-cause mortality by about 2% in India. Another study (Malhotra and Do, 2017) found health systems were more responsive if they spent more on public health. There remains an important gap in the literature around the association between public spending on health and how people use the health system.

To fill this important evidence gap, our study examined (a) the relationships between state-level public spending on health and the decision as to whether to seek care or not, (b) the relationships between state-level public spending on health and choice of medical provider, and (c) whether these relationships varied by socioeconomic groups.

1.1. Research framework

Economic theory suggests that individuals' choice of healthcare services is a function of provider attributes or characteristics, such as the distance to providers, perceived quality (itself often broken down into components such as reliability of medicines supply, respectful behaviour of health workers and so on) and the per unit prices of the services. As an illustration, if there are C healthcare provider attributes $i = 1, \ldots C$, that an individual values s/he will choose private care over public care if

$$\sum_{i=1}^{C} \omega_i A_i^{Pub} - P^{public} < \sum_{i=1}^{C} \omega_i A_i^{Pvt} - P^{private}$$

Here A_i^{Pub} is the magnitude of attribute i in public sector health services (e.g., distance to a facility), and A_i^{Pvt} is the magnitude of attribute i in public sector health services; ω_i is the marginal utility (in monetary terms) of attribute i, and P^j is the price per unit of service charged by provider j ($j = public, private$).

If increases in public expenditure leads to increases in one or more attributes A_i^{Pub} in public services (e.g., lowered physical distance, improved quality, or lower price) that are valued by the patient, that will lead to an increase in the left-hand side of the above expression, making public services more desirable. Public health care is in principle free in India, though informal charges are levied (Schaaf and Dasgupta, 2019; Tripathi et al., 2020). While the aetiology of the practice of levying informal charges is complex, increased resources available within a public facility may lower informal charging behaviours. As another illustration, a study of the drivers of treatment seeking in Madhya Pradesh found distance to be a major determinant of provider choice (Singh et al., 2017). Higher levels of public health expenditure could also be used to expand public health care infrastructure, and presumably quality of care, as occurred under the National Rural Health Mission and lead to increased satisfaction with public sector health services (EP et al., 2020).

However, if increased spending on health does not affect these attributes (e.g., due to corruption, poor management and oversight, poor responsiveness, or poor performance incentives), consumer choices across providers will remain largely unaffected.

From a normative standpoint, a finding that higher levels of public expenditure improve the relative value proposition of public health providers compared to private providers broadly implies an improvement in social welfare improvement due to higher public spending. We would characterise the welfare gain as being largely driven by quality improvements in the public sector, with a switch from poor quality private providers to public services. A recent study in Madhya Pradesh showed that almost of 77% of people surveyed in a sample of 100 villages visited private providers with no formal training (Das and Mohpal, 2016). These visits are outpatient visits and suggest that the category 'private outpatient' may be dominated by such providers.

2. Methods

2.1. Data source

This study used two main sources of data. The first was a nationally representative household survey data gathered in the 71st round of the Indian National Sample Survey (NSS) conducted in 2014. The survey gathered cross-sectional individual-level information on self-reported illness in the past 15 days, healthcare use and type of provider visited, out of pocket health expenditures, sources of healthcare financing, and a range of household and individual socioeconomic and demographic characteristics from 65,932 households, containing 333,104 individuals (National Sample Survey Of, 2016). A detailed description of the survey objectives and methods, characterized by a multi-stage stratified design, has been reported elsewhere (National Sample Survey Of, 2016; Ministry of Statistics and Programme ImplementationOffice, 2013; Office,

2013). Second, we included state-level information on government health spending per capita in individual states from the 2016 National Health Profile report (Central Bureau of Health Intelligence, 2016) net domestic product (NSDP) per capita from the Reserve Bank of India (RBI) (Reserve Bank of India. Ha, 2019).

For our analysis, we excluded data from households in three small union territories (Daman & Diu, Dadra & Nagar Haveli, and Lakshadweep), which lacked information to the same level as other states on government healthcare spending or net state domestic product (NSDP) in 2014, resulting in 0.6% respondents being dropped from the sample. In addition, our analysis was limited to adults (aged 15 and above) who had reported an ailment in 15 days preceding the survey. We used individuals aged 15 years and older as a proxy for those who made their own healthcare decisions, as including those who made healthcare decisions for others adds another layer of decision making. Healthcare provider use related to pregnancy and childbirth was included in our analysis, as the sample of women involved was 15 years and over. Finally, we removed individuals that had missing information on the outcomes of interest (healthcare use indicators) and covariates (0.01% of the sample) from our analysis. These adjustments resulted in 26,142 respondents with 29,342 instances of ailment.

For exploring choices between different providers, we limited our analysis to include 22,881 individuals who reported exactly one ailment. This was done to avoid potential complications in estimation arising from correlated ailments. If, for example, one reported ailment (and associated choice of provider) was sequentially associated, or otherwise correlated, with another for the same individual, this would violate not only the statistical independence of error terms across observations in some models, but potentially also a key assumption of the multinomial model that we estimate in this paper (specifically, 'independence of irrelevant alternatives'). To assess the sensitivity of our estimates to our choice of sample, we also report estimates for the complete dataset that included individuals with multiple ailments, where ailments were classed as either '2 ailments' or '3 or more ailments'.

See Exhibit A1 for the sample flowchart.

2.2. Variables

The two main outcome variables were: (a) whether patients sought treatment for their ailment (yes/no); and (b) if they sought care, their choice of medical provider. Provider choices were classified into 9 categories (1): outpatient in a government clinic [base outcome] (2); outpatient in a government hospital (3); outpatient in a private clinic (4); outpatient in a private hospital (5); outpatient in other facility (6); inpatient in a government clinic (7); inpatient in a government hospital (8); inpatient in a private clinic; and (9) inpatient in a private hospital. These options are further described in Exhibit A2. We used these nine categories of healthcare provider in assessing the drivers of provider choices instead of a simple public-private split to allow the differences within private and public sectors to be captured in our analyses, given our hypotheses. For instance, we expect that increased public spending may lower private care, particularly care of an informal nature, or services at the lower end of the care spectrum. Additionally, an analysis of an aggregated set of three choices - public care, no treatment, and private care – was undertaken to assess the robustness of our findings to the construction of the provider choice set.

In our regression analyses to assess the implications of government health spending for the decisions to seek care and choice of provider, we adjusted for potential confounders at individual, household and state levels. These variables included, at the individual level, age group (15–29, 30–44, 45–59, 60–69, 70+) gender, educational attainment (did not complete secondary education, completed secondary education, or completed tertiary education), marital status, religion, type of ailment (this included 15 groups of medical conditions, listed in appendix exhibit A3, and described in Schedule 25.0 survey of the 71st NSS (National Sample Survey Of, 2016)). At the household level, we included an indicator of residence (rural versus urban), caste (Scheduled Caste (SC), Scheduled Tribe (ST), Other Backward Classes (OBC), or Other Classes (OC)), and monthly per capita consumer expenditure. (see Exhibit A4 which compares our numbers with the *Health in India* report (Ministry of Statistics and Programme Implementation, 2014)). State-level information on NSDP per capita was also included. The list of household and individual level variables and expenditure per capita (a proxy for household permanent income) used in our analyses is standard in the literature for India and other LMICs (see, for instance (Farahani et al., 2010)). The use of state-level NSDP per capita is intended to capture in the model the overall wealth of a state.

2.3. Statistical approach

We examined the relationships between public spending on health, the likelihood of seeking treatment and choice of medical provider using the following two regression-based approaches (1) Multilevel logistic/multinomial regression; and (2) Instrumental variable regression models. We investigated the differential impacts of public spending on healthcare utilisation by socioeconomic groups.

In the multilevel regression analysis, we first applied a two-level multilevel logistic model (at the individual and state levels) to examine he associations between per capita public spending on health at the state-level and the decision on whether to seek care or not. The use of the multilevel model allows for non-independence of observations within groups while controlling for predictors at the instance of individual, household and state levels. The list of variables used as controls in our regression model is indicated above.

Second, we used a two-level multilevel multinomial logit regression model to examine the association between per capita public spending on health in states and the choice of healthcare provider among those who sought care. The regression model we used is a mixed general linear model with linearly related predictors and a multinomial logit link (Farahani et al., 2010; McCullagh and Nelder, 1989; Snijders and Bosker, 2012). Our model can be expressed as the following equation system (Grilli and Rampichini, 2007):

Multinomial logit link:

$$P(Y_{ij} = m \,|x_{ij},\ \varepsilon_{ij},\ \delta_j) = \frac{\exp\{n_{ij}{}^{(m)}\}}{1 + \sum_{l=2}^{M} \exp\{n_{ij}{}^{(m)}\}}$$

Linear predictors:

$$n_{ij}{}^{(m)} = \alpha^{(m)} + \beta^{(m)'} x_{ij} + \varepsilon_j{}^{(m)} + \delta_{ij}{}^{(m)}$$

Here m refers to providers, $m = 1, \ldots M$, where M are the different healthcare provider types (thus m represents each choice). J refers to state "j" ($j = 1, \ldots J$), so J is the number of states; and "i" denotes ailment type ($i = 1, \ldots I$). x refers to the collection of the explanatory variables, ε is the error term for state level variables, and δ is the error term corresponding to ailment level variables. Note that ε and x have both i and j with them, meaning that these terms will be correlated across individuals/ailments within each state and δ has only j with it, meaning this error term statistically independent across ailments/observations.

To describe heterogenous healthcare utilisation across states, a state level ordinary least squares regression was performed, summarising the association between a state's PSH-PC and both the percentage of healthcare delivered by the public system and the percentage of ailing people who sought care. These results are available in the appendix, in Exhibit A6 and Exhibit A7.

We assessed, using the Spearman rank correlation coefficient and ordinary least squares, the state level association between PSH PC and the proportion of patients seeking treatment ($r_s = 0.31$, $p = 0.08$), and the proportion of patients using government medical providers ($r_s = 0.59$, $p < 0.001$). We tested for multicollinearity for covariates controlled for in our analysis. The multicollinearity diagnostic Variance Inflation Factors (VIF) were all less than 3, indicating that there was low

collinearity among predictor variables (O'Brien, 2007). In addition, for the number of users of each provider choice in each state, using a two-way random-effects approach, the intracluster correlation was 0.68, meaning a large amount of variation in the number of people using each type of provider was due to state level variation, thus justifying a multilevel approach.

2.4. Endogeneity

The potential endogeneity of public spending on health presents a major threat to our results. Specifically, in addition to higher public spending influencing use of public healthcare facilities, it may also be that higher use of public healthcare facilities drives governments to spend more on healthcare. A two-way causal relationship between public spending on health and heath care use can bias estimates of the impact of public spending. The estimated effect of public spending on healthcare use can be upwardly biased, for example, when effects in both directions (from public spending to healthcare use, and from healthcare use to public spending) are positive. To address this, we used an instrumental variable (IV) approach. In our case, this meant using a suitable instrument (variable) which is correlated with public spending per capita (exposure), but not with provider choice or decision to seek treatment (outcome), *except* via improved spending on health.

We used the gross fiscal deficit per capita in each state as an instrumental variable for the public spending on health. This variable has been previously used in other studies that have assessed the impact of public spending on health in India (Farahani et al., 2010). The gross fiscal deficit can be expected to reduce the 'fiscal space' of the states, and thereby prevent them to devote more resources to improving the health status of its population (Barenberg et al., 2017). As gross fiscal deficit is caused by states' revenue deficit and other macroeconomic factors (Varatharajan, 2004) not expected expenditures [such as spending on health], it is likely that higher fiscal deficits will only have indirect impact on patients' choice of medical provider through its influences on the public spending on health, but will not otherwise directly affects patients' treatment seeking behaviour.

A two-stage multinomial regression is used to control for endogeneity of public health spending. The first-stage regression uses ordinary least squares to predict the public health spending as a function of the state gross fiscal deficit. In the second stage we used the predicted value of the health spending as well as other exogenous variable to estimate the probability of seeking care, and choice of medical provider (Farahani et al., 2010). More specifically, the IV estimator uses the instrument to predict the value of the potentially endogenous regressor. The predicted values are then used as a regressor in the original model.

To evaluate if it was an appropriate IV we tested the association between PSH PC and GFD PC using bivariate ordinary least squares (OLS) regression analysis. The IV (GFD PC) was associated with PSH PC (OLS: regression coefficient = 0.154, $p = 0.012$; $t = 2.65$ and the model had constant = 895, $r2 = 0.20$, $f = 7.05$, and $p = 0.012$).

That PSH-PC and GFD-PC were positively associated was unexpected, Farahani et al. (2010) had used the same IV but found a negative association. Therefore, we undertook a literature search to examine whether public health policy decisions on public spending on health had changed over the last two decades. While the idea of public spending on health as investment is well established (Mushkin, 1962) the idea started gaining momentum again in the 2000's (Chang and Ying, 2006) for high income countries. Several studies confirming the causal relationship between PSH and improved economic outcomes for that country (Aboubacar and Xu, 2017; Erçelik, 2018; Rahman, 2011) in LMICs have occurred since. This move from PSH being considered a cost to PSH being considered and investment may explain this difference.

2.5. Differential effects by socioeconomic groups

Given our hypothesis that economically and socially disadvantaged individuals were more likely to respond to improved access to public services (or improvements in public service quality), we also investigated whether location (rural versus urban), gender, income, caste and age group variables modified the association between public spending on health and provider choice (and healthcare use).

Analysis of sub-group effects was undertaken by introduction interaction terms in our model, with public spending on health interacted with relevant socioeconomic and demographic characteristics of interest. Six models were used for this purpose (1): a base model without any interaction terms (2); a model with an interaction term for gender (3) a model with an interaction term for rural residence (4); a model with per capita spending on health interaction with per capita household expenditure quintiles (5); caste [Scheduled Caste, Scheduled Tribe, Other Backwards Classes, or Other Classes]; and (6) age groups.

2.6. Robustness checks

We performed several types of sensitivity analyses to assess the robustness of the findings to alternative model specifications. The first set of analyses used the same model as outlined above for the main analyses, but only using data from only one person within each household, as sometimes multiple persons reported ailments within each household. Including multiple individuals (with ailments) from households would ideally require taking account of correlated observations (clustering of errors) at the household level. In the main analyses, however, this correlation was not able to be taken into account (that is, we effectively assumed that these observations were independent of each other) due to the inability of the multilevel model to converge at three levels. In the sensitivity analyses, by only including one random person from each household, the assumption was no longer needed although the sample size was further reduced to 17,833 people with ailments.

The second set of analyses estimated our main model but restricting the observations to only from the 19 largest states in India. This was done to address the risk that unaccounted for differences between large and small states could be driving our results. Large states here were defined as those with populations exceeding 10 million.

The third set of sensitivity analyses included all individuals who had at least one ailment, even if they had multiple ailments. Here, individuals with only one ailment had their ailment attributed to them, but for individuals with multiple ailments no specific ailment was recorded, only whether they had exactly 2, or 3 or more.

The fourth category of sensitivity analyses used a slightly different model that aggregated some of the treatment options: outpatient service in a private hospital and clinic, inpatient service in a government hospital and clinic, and inpatient in private hospitals and clinic. This was done because of potential similarity between these groupings.

A final set of sensitivity analyses combined data from all individuals for estimating a model that aggregate people into three categories: a) did not seek care, b) sought care at a public facility, or c) sought care at a public facility. This was done to ensure added comparability to other studies.

The study is a secondary analysis of existing publicly available survey data obtained from the National Sample Survey (NSS) in 2014. As such ethics approval was obtained for access to the database but not for specific analysis. Ethics Approval was obtained from the University of Melbourne, Medicine and Dentistry Human Ethics Sub-Committee. ID: 1,852,933.

3. Results

Exhibit 1 presents the respondents' socio-economic and demographic characteristics. The median age of the respondents was 50 years. There were slightly more male (55%) respondents than female (45%). 71% of the respondents had an educational attainment of primary school completed or less, and 51% resided in a rural area. 23.3% of

	No Treatment		Government Clinic		Government Hospital		Private Hospital		Private Doctor/Clinic		Other		Total	
	number	percent	number	percent	number	percent	number	percent	number	percent	number	percent	number	percent
Outpatient	778	2.98%	1,578	6.04%	3,297	12.61%	4,686	17.93%	8,826	33.76%	2,191	8.38%		
Inpatient	-	-	251	0.96%	1,387	5.31%	2,322	8.88%	826	3.16%	-	-	26,142	100.00%

Exhibit 1. The number and percentage of people in the sample who used each type of provider.

the sample were from a Scheduled Caste or Tribe, 41.4% were from an Other Backwards Class' (OBC), and 35.3% were in neither category. The share of visits to different healthcare providers is reported in exhibit 1.

Our data shows the majority (96.9%) of patients sought healthcare when they experienced ill health. Private healthcare for outpatient care was preferred to government care. In our sample, 33.8% of people sought outpatient treatment at private clinics, 51% sought outpatient treatment at private facilities (including private hospitals), 6% made outpatient visits to government clinics (18.6% overall, including outpatient visits to government hospitals). For inpatient care among individuals reporting treatment in the 5 days preceding the survey, private care was also preferred though not to the same level, with 6.3% of total visits being as inpatients to government facilities and 12% to private facilities. 8.4% of the sample sought care from either a "medicine shop" or "other" (National Sample Survey Of, 2016). See Exhibit A5.

We found significant socioeconomic patterning of health seeking behaviour in India. The most deprived (expenditure) quintile had a higher proportion reporting 'no treatment' or outpatient government clinic use, as well as a lower proportion going as inpatients to private hospitals. The most advantaged had a higher proportion attending private hospitals as outpatients. The proportion of individuals using outpatient private clinics was similar across expenditure quintiles.

3.1. Healthcare seeking behaviour

In the state level regression, we found no statistically significant correlation between Indian states with higher PSH PC and proportion of sick people who sought care (OLS: $r^2 = 0.012$, $p = 0.54$, Spearman: $r_s = 0.31$, $p = 0.08$). This is shown in Exhibit A6.

To examine the association between public spending on health per capita and the odds of seeking any care (if reporting an ailment in the 15 days preceding the survey), a multilevel logit model was used. Exhibit 2 shows the odds ratios for choosing any treatment compared to no treatment. Across six models (with different interaction terms) and the sensitivity analyses, an increase of INR100 per capita public spending on health was found not to be associated with an increased likelihood of seeking treatment in any model, (OR between 1.01 and 1.05 with none having $p < 0.05$). Estimates from the IV regressions ranged from 0.94 to 0.99 (Exhibit 2), though having wider confidence intervals all crossing the null, suggesting there was no statistically significant association between PSH and decision to seek healthcare ($p > 0.05$). The sensitivity analyses also showed no association.

3.2. Choice of provider, conditional on care being sought

In the state level regression, we found a positive association between PSH PC and the proportion of healthcare delivered by government healthcare providers (OLS: coef = 0.015, $p < 0.001$ and $r^2 = 0.47$, $p < 0.001$, Spearman: $r_s = 0.59$, $p < 0.001$)), see Exhibit A7.

Although our research showed no association between a INR100 increase in public spending on health per capita and the odds of seeking care, we also hypothesised that there would be an increased likelihood of seeking care from a public provider among those who sought care. For this purpose, we examined the relationship between public health sending and the odds of using each provider, relative to using a government clinic (as an outpatient). Across all models, an increase of INR100 in public health spending per capita was associated with decreased odds of using outpatient care at a private hospital (OR: 0.91–0.94, all $p \leq 0.001$), as well for using outpatient care at a private clinic (OR: 0.83–0.91, all $p < 0.001$)). There was also decreased odds of using inpatient care at a private hospital (OR: 0.89–0.94 $p \leq 0.002$) and decreased odds of using inpatient care at a private clinic (OR: 0.86–0.95, $p \leq 0.002$). ORs for a INR100 increase in public health spending capita for each model are reported in Exhibit A8.

Similar results were observed when the models were estimated using an instrumental variable approach. These analyses were identical except predicted value of PSH-PC given GFD-PC was used in place of PSH-PC. There was a reduction in the odds of using private hospital for outpatient care (OR: 0.88–0.95, although two models with interaction terms for UMPCE quintile and age had confidence intervals which crossed the null). As in the analyses that did not use the IV approach, when using the IV approach the odds of using private clinics for outpatient care were negatively associated with increases in public health spending per capita (OR: 0.87–0.91, all $p \leq 0.01$). The ORs for the association of public

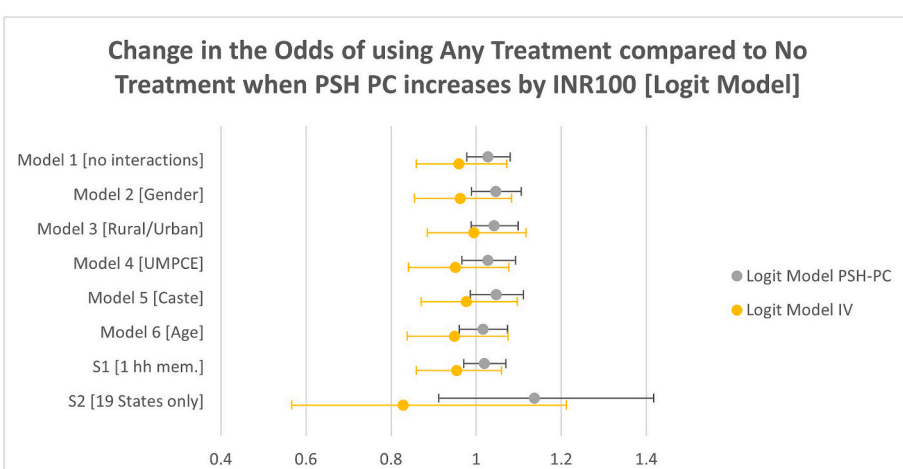

Exhibit 2. The associations between state level public spending on health and decision whether to seek any treatment.

health spending and each provider choice for the full set of models used in the paper is reported in Exhibit A8. Both the IV and main analysis results are visualised in Exhibit 3.

3.3. Differential effects by sub-groups

As outlined in the methods section, we tested whether the association between public health spending per capita and outcomes varied across different population groups, using interaction terms. We found age groups are not differentially associated with the impact of public spending on healthcare provider choice. However, the association between public spending on health and healthcare provider choice varies by gender, residence (rural versus urban), caste, and household per capita expenditure quintile (our proxy for permanent income).

Six models were used to test for effect modification by covariates using interaction terms (see methods section). Model 1 had no interaction terms.

Model 2 examined the modification of the association by sex. A INR100 increase in PSH PC only had significant results for both the interaction term and PSH-PC for inpatient private clinics, OR [of choosing this provider compared to outpatient government clinic when PSH-PC increased by INR100]: 0.91 for women compared to 0.86 for men ($p = 0.02$ [h_0 being women = men]]). When using the IV, OR: 0.86 for women compared to 0.77 for men ($p = 0.02$).

Model 3 examined the modification of the association by rural/urban residence. A INR100 increase in PSH PC only had significant results, in both the interaction term and PSH-PC, for inpatient private clinics and outpatient private clinics. For inpatient private clinics OR: 0.86 for rural but 0.93 for urban ($p = 0.001$), with the IV OR: 0.77 for rural but 0.87 for urban ($p = 0.01$). For outpatient private clinics OR: 0.86 for rural but 0.90 for urban ($p < 0.001$), with the IV OR: 0.87 for rural but 0.92 for urban ($p = 0.03$).

In Model 4, the interaction terms for household per capita expenditure quintiles had significant results. An INR100 increase in PSH PC was associated with a smaller decrease in the odds of using outpatient private clinics (compared to outpatient government clinic) for those in the highest three UMPCE quintiles (compared to the most deprived UMPCE quintile). ORs for the additional effects for all quintiles are shown in Exhibit 4 and visualised in Exhibit 5.

When using the IV in the analysis in place of PSH PC, no significant associations was found. As with all IV results, much wider confidence intervals were seen.

Model 5 included an interaction term for caste. Some provider choices had significant results for both PSH-PC and the interaction terms. Outpatient private hospitals had an OR of 0.93 for Scheduled Castes but 0.90 for Other Classes ($p = 0.01$), the IV analysis was not significant. Similarly, outpatient private clinic had an OR of 0.91 for Scheduled Castes but 0.86 for Other Classes ($p = 0.002$), the IV analysis was not significant. Interaction terms were similar for inpatient private hospital and inpatient private clinic with Scheduled Tribes, Other

	PSH-PC			GFD PC (IV)		
	additional OR	95%CI Low	95%CI Up	additional OR	95%CI Low	95%CI Up
0-20%	1	-	-	1	-	-
20-40%	1.004976	0.957203	1.055132	1.005669	0.926392	1.091729
40-60%	1.05273	1.005034	1.102689	0.988789	0.914455	1.069165
60-80%	1.049558	1.004034	1.097146	0.989731	0.916616	1.068677
80-100%	1.097032	1.050565	1.145555	1.051569	0.973439	1.135969

Exhibit 4. Difference in the association between a ₹100 increase in PSH PC and choosing a private clinic (outpatient) for UMPCE quintile. **BOLD** significant at 90%, **BOLD** with * significant at 95%. Interpretation: these ORs are multiplied with the OR of PSH PC (0.83), thus an OR greater than 1.00 here still shows a decrease in the odds of using a private clinic compared to a government one for outpatient care, but a significant result with an OR above 1.00 means for this group the association is weaker.

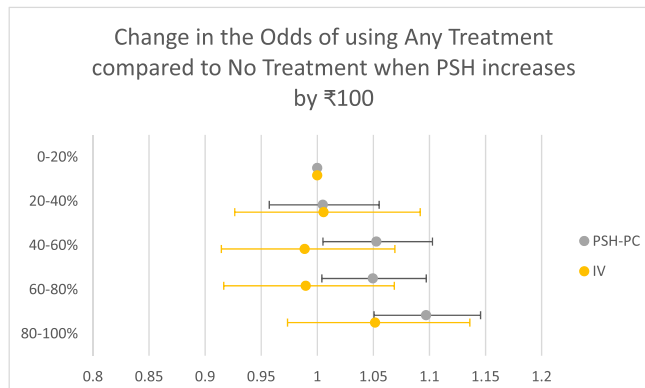

Exhibit 5. Difference in the association between a ₹100 increase in PSH PC and choosing a private clinic (outpatient) for UMPCE quintile. Derived from Exhibit 5.

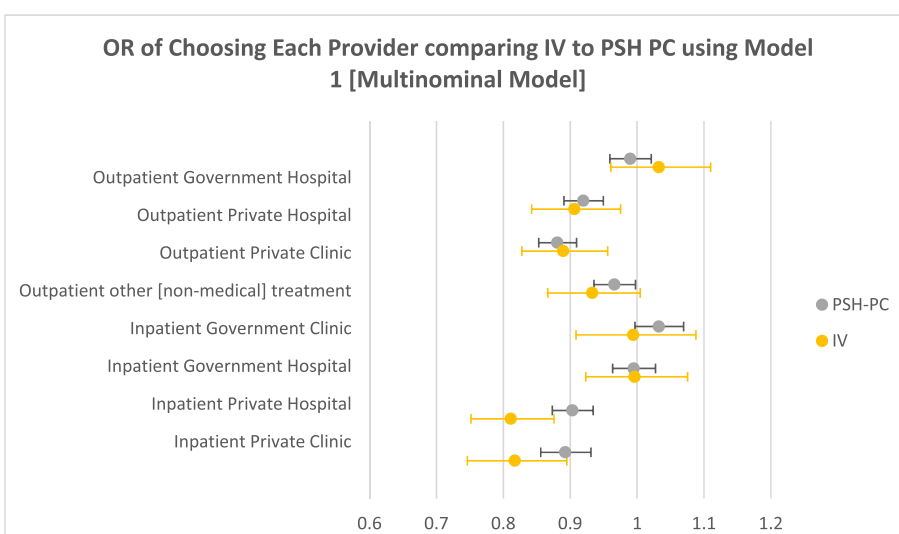

Exhibit 3. The association between state level public spending on health and choice of provider using multinomial model.

Backwards Classes, and Other Classes all having slightly more reduced odds of using these providers compared to Scheduled Castes given an increase in PSH-PC of INR100.

Model 6 included an interaction term for age categories. There was only a single age category for a single provider which had a significant result, and there was no observable pattern. The IV analyses produced similar findings.

3.4. Robustness checks' findings

Both the decision to seek care and the choice of provider analyses included sensitivity analyses. The results between the six main models and the sensitivity analyses only including one household member were similar, suggesting that results in the main models were likely to be robust to a variety of departures of the assumptions underpinning the model. See Exhibit A9.

The sensitivity analysis only including 19 large states generally followed the same pattern of association for different provider types. The only large difference was that outpatient private hospital had an increase in the odds ratio when all the other analyses saw a decrease (OR: 0.92, $p < 0.001$in the model 1 to OR: 1.15, $p = 0.15$ in the 19 states analysis). There was a much larger reduction observed for inpatient private clinic use (OR of 0.69, $p < 0.001$ in the 19 states analysis compared to 0.85–0.92 across all 6 main models, all $p < 0.001$). The result for outpatient private clinic was a similar reduction to the main models and remained significant. See Exhibit A9.

The sensitivity analysis using all individuals with only one ailment showed nearly identical results to the main analyses, indicating that limiting the main results to only those with one ailment did not skew the results. See Exhibit A9.

The sensitivity analysis with the combined outcomes of outpatient private hospital/clinic, inpatient government hospital/clinic, and inpatient private hospital/clinic showed very similar results to the main analyses. See Exhibit A10 for more detail. The simplified no treatment, public provider, or private provider analysis also showed very similar results to the main analyses. See Exhibit A11 for more detail.

4. Discussion

Our study is the first study in the scientific literature to systematically examine the associations between state-level public spending on health per capita and choice of medical provider in India. Our findings indicate that state-level public spending on health per capita was not associated with a significant change in the odds of seeking treatment by patients with an ailment. Nevertheless, our findings (in both multinomial and instrumental variable regression models) suggest statistically significant association between public spending on health per capita and choice of medical provider for people who choose to seek care. Our results also revealed that an increase in state-level public spending on health per capita by INR100 in India was associated with a greater reduction in the odds of choosing a private clinic (outpatient) compared to a government clinic (outpatient) in the most deprived (a 17% reduction) compared to the most affluent (9%). Collectively, these results clearly indicate that policies which increase public spending on health per capita are associated with a shift in healthcare seeking behaviour towards government medical providers in India, across gender and socioeconomic groups.

The lack of association between public spending on health per capita and the decision to seek care when ailing is expected. This aligns with previous literature that the most important factor when choosing whether to seek care or not is the severity of the ailment (Geitona et al., 2007; Nelson et al., 1998; Xuedan and Yasuki, 2011). However, as illustrated in the research framework section of the study, the shift in patients' use of medical providers from private outpatient facilities to public facilities provides evidence that some combination of affordability, access, and quality improves as public spending on health per capita increases. This increases the odds of patients using public outpatient clinics, with the biggest normative reduction coming from outpatient private clinics. Further as the poorest are the mostly likely to have few options and be forced to seek care at what they know are low-quality providers due to cost constraints, the expected result of increased public spending on health per capita would be largest among the poor. This is seen in our results.

While a large proportion of healthcare in India is provided by the private sector, it remains a challenge for the India's government to monitor and regulate quality of health care at private sector (Drèze and Sen, 2002, 2013; Mackintosh et al., 2016; Sheikh et al., 2015). Several strategies have been proposed to improve the quality of care at the private health care, including requirements for medical practitioners to obtain licenses (Sheikh et al., 2015) and efforts to train informal providers, and compensation for injury related to medical negligence. (Mohanan et al., 2016). Our results provide some evidence for the idea of 'regulation by competition', which suggests that by improving the quality of care at the public sector this will eventually lead to improved quality of health care at the private sector, through competition of customers between the public and private health care providers (McPake and Hanson, 2016). The regulation by competition offers governments a potential pathway in which they can regulate markets which are difficult to regulate. By ensuring a good quality public healthcare system, governments ensure that consumers will demand private care equal to, or above, the quality offered by the public system. This means as the quality of the public system goes up, so too shall the private system, as low-quality private providers are driven out of business by the public system. Unfortunately, the NSS dataset does not contains information on quality of care. Further studies are warranted to examine the effect of public spending on health on quality of care for both public and private health care in India.

4.1. Study limitations

There are several important limitations to recognise in the study. First, the NSS lacks objective data on the quality of healthcare providers. The NSS collects data on whether a provider is a clinic or hospital, private or government but these are not indicators of quality. Further studies which assess the relationship between quality of care and patients' choice of medical provider in India are warranted. This study is one of the first to include ailment type as a control variable, when looking at healthcare provider choice and PSH. Severity of ailment was not measured by the NSS so could not be included in our model. Further these classifications, both provider and ailment, were made based upon what respondents told their interviewer, this creates the potential for recall bias or simple misattribution to bias the results. This is of particular note in that different groups self-report ailments at significantly different rates (Subramanian et al., 2009; Vellakkal et al., 2013).

The main limitation of the study is the use of a cross-sectional design, meaning that it remains unclear whether any inference regarding causation is appropriate. While the previous NSS surveys have collected data on which type of healthcare provider used. The last one to collect healthcare utilisation data did not do so in a comparable way to the 2014 NSS this study used. In 2017 another round of healthcare utilisation data was collected, however actual accounts for state level spending on healthcare are still not available. This makes a panel data study design currently unfeasible, although it may present an opportunity for further research in the future.

To address this, we investigate the associations between public spending on health and choice of medical provider using two regression-based approaches. The results from both models yields very comparable results which suggests they are robust.

Another limitation is that the instrument variable is weak. The F stat of 7.05 is less than the general rule of 10 ((Stock and Yogo, 2005)). Following recommendation from previous studies (Barenberg et al., 2017), we tested the validity of our findings by restricting to only 19

large states. Our results from only 19 states were broadly comparable with those from the entire sample.

The study lacks consistent information on how public spending on health in each state is spent, whether direct provision of public healthcare or the public funding of a health insurance scheme which uses both public and private facilities. This is a limitation. Being able to perform analyses on how the component breakdown of public spending on health affects healthcare provider choice would better inform policy decision. However, consistent information on how much each state spent in different areas is not publicly available.

Lastly, our study focused on health seeking behaviour for healthcare treatment rather than prevention, there is scope for further research to examine the impact of public spending on health per capita on uptake of and choice about preventative treatment.

4.2. Policy implications

The key finding of our study is that increased public spending on health per capita leads to a shift in health seeking behaviour from private to government healthcare providers in India. A potential reason behind this association is improved quality and accessibility of care at government health facilities due to increased resource allocation, resulting in changes in patients' choice of medical providers.

The policy implication of this finding together with its proposed explanation is that regulation of poor-quality private sector health care might be feasible by strengthening the public sector. Rather than seeking to enforce rules about private sector provision such as those restricting practice to people with appropriate qualifications and facilities with appropriate space, equipment, and other resources. Ensuring that a better quality, accessible, and affordable source of care exists for everyone, and especially the poorest groups, allows people to 'vote with their feet' and suppress the business of poor-quality private sector providers including those who lack qualifications or adequate facilities.

In concert with other evidence on the prevalence of hazardous service provision in India and elsewhere (Sheikh and George, 2012; Drèze and Sen, 2013; Mohanan et al., 2016), these findings provide a strong justification for investing in and strengthening public health services in India. India is therefore making good choices in its current reforms and decisions to significantly increase public health expenditure.

Credit

Patrick Mulcahy, Conceptualization, Data curation, Methodology, Formal analysis, Investigation, Roles/Writing - original draft; Ajay Mahal, Formal analysis, Investigation, Methodology, Writing – review & editing; Barbara McPake, Funding acquisition, Investigation, Project administration, Writing – review & editing; Sumit Kane, Investigation, Writing – review & editing; Prabir Kumar Ghosh, Data curation and John Tayu Lee, Investigation, Project administration, Supervision, Writing – review & editing.

Declaration of competing interest

The authors have reported no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2021.114149.

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